

Towards a Post-2012 Climate Change Regime

Final Report

K.Blok, N.Höhne, A. Torvanger, R. Janzic

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Author: K.Blok, N.Höhne, A. Torvanger, R. Jancic
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Executive Summary

1. Introduction

It is broadly recognised that the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), the result of years of intensive international negotiations, is only the first step in combating human-induced climate change. Further action is necessary to reach the ultimate objective of the UNFCCC, i.e. "stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The key issue is how to share this action between all global regions and Parties to the UNFCCC.

Annex I Parties have committed themselves to reducing greenhouse gas emissions in the first commitment period 2008 to 2012 by around five per cent compared to 1990 levels. The Kyoto mechanisms, emissions trading, Joint Implementation and the Clean Development Mechanism, play a very important role. Currently, valuable experience is being gathered with the implementation of these mechanisms.

Preparations for the second commitment period have begun, but there is much uncertainty as to how the process will unfold and what a final agreement could entail. This study is set-up as support material for the European Commission on Further Action in the UNFCCC Post-2012 process. Its objective is to:

- 1) To analyze relevant country groupings and possibilities for future regimes
- 2) Collect and assess available approaches to future commitments
- 3) To come with concrete proposals for a future regime and the associated negotiation process

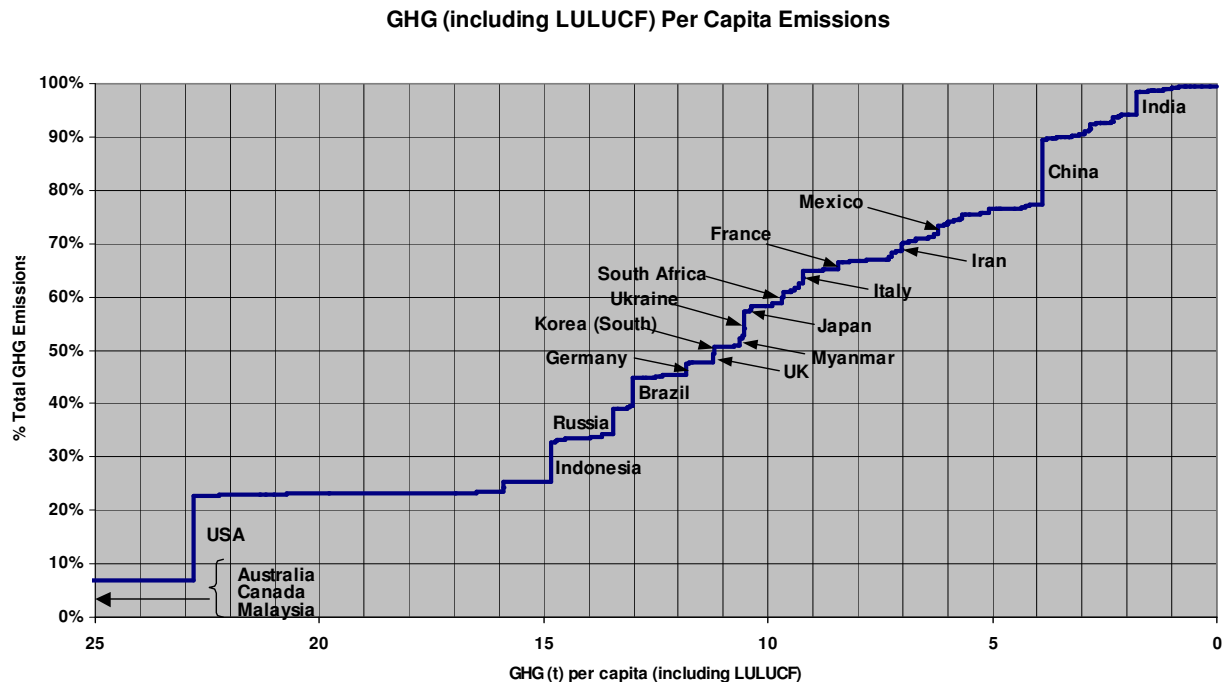
2. Possible country groupings

An analysis has first been made of the various country groupings. Current Annex-I countries are responsible for about 41% of total greenhouse gas emissions, 51% of GHG emissions if LULUCF (land use, land use change, forestry) emissions are excluded and 58 % of energy-related CO₂ emissions. Most Annex-I countries in 2000 had greenhouse gas emissions greater than 7 tCO₂-eq/cap.

An often-used criterion for taking up reduction commitments is GHG emissions per capita. Highlights of this analysis considering emission excluding LULUCF:

- Non-Annex I countries already above 9 tCO₂-eq/cap include such countries as Turkmenistan, Kazakhstan, South Korea, Taiwan, Singapore, and South Africa.
- Large emitting countries that have emission rates between 5 and 9 tCO₂-eq/cap (comprising 10% of the world's total greenhouse gas emissions) include Mexico and Iran.
- China, India and Indonesia have respectively 3.9, 1.8, and 2.4 tCO₂-eq/cap.

The effect of LULUCF emissions on a country's overall greenhouse gas emissions can be significant. Countries with the highest total LULUCF emissions are Indonesia, Brazil, and Malaysia with per capita emissions of this type ranging from 8 to 30 tonnes. LULUCF emissions are uncertain, but estimates are that they can be nearly 20% of total world GHG emissions. A review of the world's share of greenhouse gas emissions by varying per-capita emission thresholds is presented on the following page.



3. Approaches to future commitments

Regarding future protocols, a large variety of approaches have been put forward and provide methods to differentiate between countries, for example, in the time and form of participation or the stringency of their efforts. Most of these approaches are about distributing a total cap amongst a group of countries and aim at emission reductions in participating countries.

In this report we provide fact sheets as a systematic overview and brief assessment of several approaches and issues that have been proposed.

One of the most interesting proposals put forward in recent years is the multi-stage approach. The current system under the UNFCCC and the Kyoto Protocol is based on two stages, Annex I and Non-Annex I, with respective commitments. It seems likely that in the future, this differentiation of two groups may not be sufficient to fully take into account the differences between countries. A "multi-stage" approach could bridge the gap as further stages could be introduced between Annex I and Non-Annex I countries. Countries could gradually move through these stages with increasing stringency. This approach would reflect that countries today have different levels of economic development and therefore have different obligations under a future climate treaty.

Within the Kyoto Protocol there is a requirement for binding absolute targets, but there are a number of additional or complementing approaches that allow for greater flexibility. Some examples are:

- *"Dual" targets*, meaning that two targets are defined, a "selling target", below which emission rights can be sold, and a "buying target", above which emission rights have to be bought.
- *"Price cap"*, meaning that an unlimited number of additional emission rights is provided at a given maximum price.
- *Sectoral targets*, meaning emission reduction targets that apply for one sector only, instead of to whole economy.

This is important given countries differ in many respects: their level of economic activity, economic structure, energy efficiency levels, current energy sources and access to energy sources, land-use patterns as well as a number of other national circumstances.

Any proposal for a future climate regime should therefore be flexible and collectively offer “something for everyone” while fulfilling a number of environmental criteria, including the stabilization of greenhouse gas emissions, synergy with sustainable development, and incentives for innovation and early action. Common but differentiated responsibilities should be reflected and cover a broad range of countries, from the USA to developing countries.

4. Possible elements for a future agreement

With this in mind, we can define four key elements that a future regime could encompass:

- Multi-stage agreement on emission reductions of Kyoto-gases (excluding LULUCF)
- Agreement on adaptation
- Agreement on LULUCF/deforestation
- Agreement on technology

The **multistage approach** assumes that in the early stage of development, countries can increase their emissions per capita due to industrialization. In a second phase, countries that have reached a certain development needed to stabilize emissions per capita as industrialization is competed and/or efficiency gains are made on par with growth in production. Finally, countries at the highest level of development need to reduce their per capita emissions by making the economy more energy and emission efficient. The threshold for participation can decline with time as technology becomes more efficient. Such a decline is necessary to reach climate stabilization targets.

A multistage setting may result in a relatively complicated system, as many decisions have to be taken regarding the threshold for participation, the different types of commitments in the stages and the differentiation of the stringency of the commitments, but it does offer a means perhaps most conducive to reaching agreement. To make things more concrete, the table below provides a proposal for a three-stage approach. The only aim of this outline is to show how a multi-stage agreement could be envisaged. However, there are still many parameters that can be used to further develop the approach in a negotiation process.

Multi-stage emission reduction agreement: country groupings and targets

Group	Criterion for participation in 2020 (cut-offs based on today's levels, indicative)	Ambition level of commitments in 2020	Types of targets	Differentiation of targets
A	Annex I countries and countries with GHG emissions larger than 9 tCO ₂ -eq/cap, i.e. 2/3 of current Annex I average and excluding countries with less than US\$4000/capita GDP	15% to 30% average reduction from 1990	Absolute emission reduction targets	Sectoral burden differentiation approach, such as Triptych
B	GHG emissions 5 - 9 tCO ₂ -eq/cap, i.e. between 1/3 and 2/3 of current Annex I average excluding countries with less than US\$4000/capita GDP	Per capita stabilization 2010 to 2020	Dual targets or price caps Alternatively: sectoral targets for important sectors	Individual target setting
C	GHG emissions less than 5 tCO ₂ -eq/cap and all countries with less than US\$4000/capita GDP	Emission limitation efforts	No binding overall targets but sectoral agreements (possibly dynamic targets) for some sectors and assistance provided to reduce greenhouse gas emissions	Not applicable

These parameters are in line to keep the option of stabilizing CO₂ concentration at 450 ppmv open until 2020, but more stringent reductions are required after 2020 to keep the 450 ppmv within reach.

Adaptation to climate change, our second element, is increasingly one of the key issues of concern for all countries but in particular for developing countries. Discussions to address mitigation efforts on the part of developing countries are likely to be more fruitful if developed countries can already clearly demonstrate a commitment to addressing adaptation. Adaptation should therefore form part of the final negotiation package.

Despite the uncertainty, it is likely that yearly costs required to address adaptation issues will be considerable. An agreement on adaptation could be done under existing negotiations or under a separate legal instrument. Applying 'the-polluter-pays' principle could mean to introduce a levy on greenhouse gas emissions and use this to pay for the costs of adaptation. For example, a relatively small levy of €0.5 - €1.0 per tonne of CO₂-eq. on all current global greenhouse gas emissions would raise a fund of approximately 20 - 40 billion Euros. Starting contributions with perhaps a €0.1 - €0.25 per tonne of CO₂-eq. level would be useful as a substantial starter to an adaptation fund. A levy could be applied differently to Groups A, B and C. defined in the multi-stage section above. Group B countries' contribution could be half the rate paid by Annex I countries, perhaps the final goal being a €0.50 per tonne CO₂-eq. on their greenhouse gas emissions. Group C countries could make contributions at rates equal to or less than that of Group B countries, but primarily as their own contributions to domestic mitigation efforts. Generated revenue could be focussed on first implementing projects identified in current national adaptation programmes of action (NAPA).

Reaching **agreement on land use, land use change and forestry (LULUCF)**, greenhouse gas emissions and removals from these activities has a significantly different character than greenhouse gas emissions from fossil fuels and were treated differently from other sectors in the Kyoto Protocol. Emissions from deforestation also stem primarily from a small number of countries and hence theoretically an agreement to include a few countries might cover a large part of those emissions.

Options for integrating activities related to land use, land-use change and forestry in a future climate agreement are summarised in the following table:

Options for land use, land-use change and forestry in a future agreement

Description of approach	Arguments made in favour of the approach	Arguments made against the approach
1. Selected LULUCF activities (voluntarily) in the Kyoto basket (continuation of the existing approach)	• High flexibility for countries to reduce emissions between sectors and gases • Could move countries to agree to more stringent targets • Selection of activities keeps amount of removals/emissions manageable	• Complicated accounting rules • High natural inter-annual variability can water down reduction efforts • Low cost LULUCF reduction options may distract from reducing fossil fuel emissions
2. All emissions and removals on managed lands in the Kyoto basket ("full carbon accounting")	• Maximum flexibility for countries to reduce emissions between sectors and gases • Could move countries to agree to more stringent targets • Simplified, but still ambitious accounting rules compared to option 1	• Need careful consideration of indirect removals due to e.g. CO₂ fertilisation • High natural inter-annual variability can water down reduction efforts • Low cost LULUCF reduction options may distract from reducing fossil fuel emissions
3. Separate quantitative emission targets for LULUCF activities, which cannot be traded with quantitative targets for other emissions	• Emphasis that emissions from deforestation <i>and</i> fossil fuels have to be reduced	• Less flexibility in reducing emissions across sectors • Process of target setting more complicated
4. Separate protocol for LULUCF activities that includes activities such as a commitment to the reduction of the deforestation rate, financial contributions for the conservation of forests, or trade of non-utilization rights of rainforests	• Separation of emissions from deforestation and from fossil fuels • Use of types of commitments best suitable for LULUCF • Uncertainty of emissions are less relevant	• More complex negotiations, as on two separate topics with new institutional structure • Agreement on climate change cannot be used for conservation of forests

And considering our final element, there is no doubt that **'technology'** should play an important role in helping to reduce or limit greenhouse gas emissions. The USA has especially put much emphasis on this aspect. Technology is both a cornerstone of the national strategy with respect to climate change, but it is also a key input of the USA to the international debate on future action.

Despite broad acceptance on the important role technology has to play, it is not so easy to envisage what a Technology Protocol would look like, but additional agreement could be reached for different targets types. Regarding the target types one can make two important distinctions:

- a focus on development of new technology versus deployment of existing (or new) technology
- a focus on input to action (effort-based) versus output of action (result based).

This provides us with the matrix of possible actions presented on the following page. Next to this, also more general agreements could be attained on the exchange of technology, ranging from 'soft' to

'hard' forms, e.g. exchange of information, capacity building, transfer of licences, transfer of equipment.

Possible target types for agreements on technology

	Input (effort-based)	Output (result-based)
Focus on technology development	1. Agreement on input (money, people) for research and technological development	2. Agreement on performance targets for technologies resulting from research and technological development
Focus on technology deployment	3. Agreements on efforts to implement new technologies	4. Agreements on targets for the implementation of new technologies

Technology targets could be developed based on a menu approach where countries subscribe to a number of options, but are not bound to all. The stringency of commitments could be measured in terms of long-term impact (e.g. the year 2050). Technology options for countries could include issues related to energy efficiency in buildings (including electric appliances), energy efficient and clean cars (and other means of transportation), energy efficiency and GHG emission reduction in the manufacturing industry, renewable energy, clean fossil fuels (including CO₂ storage and sequestration, hydrogen routes), nuclear, and low GHG agriculture.

Before conclusions can be drawn about the possible role of technology in a future protocol, it is important to acknowledge that there are different roles that this 'technology' can have in future protocol:

1. Technology is an element of a protocol that is completely additional to other elements, like agreements on quantified emission targets and on adaptation.
2. Similarly, technology is one of the elements of a protocol, but in this variant 'trading' between various elements is possible. For instance, a country might put extra effort in developing new technology that can strongly reduce emissions in the long run, but in exchange have a higher emission target in the short term.
3. A third possibility is a completely separate agreement only on technology (without an agreement on quantified emission reduction targets).

In the course of overall protocol negotiations, some exchange with other elements may be considered, but option 1 is recommended as the best means reaching agreement.

Proposal for a future regime

A possible outline for a future regime could therefore be defined as follows:

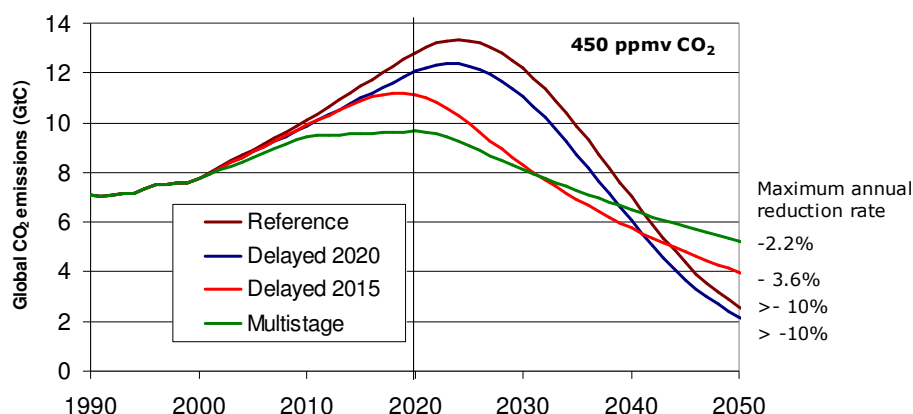
- A multi-stage agreement on emission reductions including the flexibility mechanisms of the Kyoto Protocol with the following stages
 - A. An extended Annex-I with emission reduction commitments for 2013 – 2022 in the range of 15-30% compared to 1990, to be differentiated according to some sectoral approach
 - B. An intermediate group (currently between 5 and 9 tonne CO₂-eq. per capita, excluding LULUCF) with emission reduction commitments for the period 2013 to 2022 equivalent to stabilizing emissions per capita, to be differentiated according to some sectoral approach and only for countries with more than \$4000/GDP per capita.
 - C. A third group with low emissions per capita and/or low GDP per capita with no quantitative commitments
- An agreement on an adaptation fund to be filled by Group A countries increasing from 0.1 – 1.0 \$/tonne CO₂-eq per capita. Group B countries pay half the rate. Group C countries can make use of the fund, but have to pay an own contribution of half the rate
- An agreement on LULUCF/deforestation to reduce emissions by 15 – 30% by 2020 plus financial compensation
- An agreement to develop low-cost clean technology in the areas: advanced biomass utilization and photovoltaics, carbon sequestration and hydrogen/fuel cells, advanced industrial processes

This structure of a package should satisfy environmental criteria as it would retain environmental effectiveness and provide synergy with sustainable development and technological innovation. It also would fill a number of economic criteria as it is cost effective, open and provides some certainty on cost and economic predictability. Political criteria would be addressed as it reflects common but differentiated responsibilities covering a broad range of countries, from the USA to developing countries, it broadens the regime to key countries, and has “something in it for everyone”.

Whether an agreement like the one above will be acceptable remains to be seen. Therefore, it is worthwhile to consider a phased approach for the negotiations, where initially weak agreements are accepted that are gradually sharpened.

However, a delay of only a few years has considerable consequences on the ability to keep CO₂ concentrations below 450 ppmv. The following figure shows global CO₂ emissions until 2020 under a reference case with no climate action ('Reference'), two delayed cases where the countries that ratified the Kyoto Protocol achieve their Kyoto targets, stay on that level and global reductions start as of 2020 ('Delayed 2020') or as of 2015 ('Delayed 2015') and the multistage agreement as described above ('Multistage'). After 2020, emission paths are shown that would ensure that CO₂ concentration stays below 450 ppmv. The reference case or the delay until 2020 would make it virtually impossible to stay below 450 ppmv, only with global reduction rates after 2020 higher than 10% per year. Already the delay of 5 years increases the global reduction rate per year after 2020 considerably (here from 2.2% to 3.6%).

Global CO₂ emissions under several scenarios until 2020 and emission pathways towards stabilization of CO₂ concentration at 450 ppmv



5. The negotiation process

We identify two scenarios for future agreement that we denote by 'early agreement', where agreement turns out as feasible before 2008, and 'delayed agreement', where agreement on further action is only possible at a later date. Within these scenarios, there is a further division of either a strong or weak agreement type. A weak scenario can be seen as a fall-back option in the eventuality that a strong agreement turns out to be impossible to achieve.

The feasibility of the strong/early scenario could be improved through issue-linkage since each party is likely to find at least one agreement element that has high interest. In other words there should be something in it for everyone.

The strong/delayed scenario is thinkable if early agreement turns out impossible, but stronger indications of serious consequences of man-made climate change is seen after 2012.

The weak/early scenario is thinkable if the pro-active parties realize early that a strong agreement for now is impossible, and instead go for a weak agreement for the first years of the post-2012 target period.

The main findings on the negotiation process are summarized as follows:

Timing. Negotiation planning should reflect the possibility of different scenarios with respect to a strong or weak agreement, and to early (before 2008) or delayed (around 2012) agreement.

Linking of agreement elements. The four agreement elements should be seen as integral parts of one framework. Flexibility and attractiveness is enhanced when each party can find something of high interest and is able to choose different profiles in terms of commitments across the agreement elements.

Building alliances. The interest of parties to the four agreement elements must be assessed. Negotiations should be based on the UNFCCC, and supplemented with informal discussions in smaller groups. But other international groups should be used to build up political momentum and consensus. The most willing parties should lead the way, and non-state actors be involved.

Linking with other issues. Linking negotiations to related issues such as development and climate, co-benefits in terms of reduced air pollution in developing countries, regional air pollution agreements, green technologies, and energy security, could be helpful for climate policy negotiations.

Leadership. Leadership is required from all pro-active parties in terms of meeting Kyoto commitments and showing willingness to further action. Framing, agenda and mediator leadership is required. Other nations and stakeholders must be involved, and awareness and understanding for their views and interests shown. Also, political awareness and sensitivity is important. Reframing issues, e.g. climate and development, and focal issues such as climate/green technologies, adaptation/mitigation, and climate/air pollution, can be helpful. Flexibility and policy innovation is required.

Regardless of final outcome, the EU should emphasise the following elements in its climate negotiation strategy:

1. Promote flexibility and innovation in a multi-stage negotiation process, where the four agreement elements are seen as integral parts of one framework.
2. Seek issue linkages on important areas such as technology, energy policy, development, and air pollution where this can enhance negotiations.
3. Demonstrate framing, agenda and mediator leadership together with other pro-active countries.
4. Establish dialogue with key countries such as the USA, China and India, and be sensitive to their interests and concerns.
5. Stress informal processes; the importance of informal dialogue during pre- and negotiation periods, capacity-building, and promoting the participation of non-governmental actors.

Proposal for short-term actions for the EU and other proactive countries:

- a) Communicate in writing and speech EU's policy and national policies to other parties and stakeholders, and how they together work towards reaching the Kyoto targets and prepare for climate policies beyond 2012.
- b) Initiate collaboration with ten large and vulnerable developing countries on adaptation to climate change. A first step could be to organize visits to get a better understanding of adaptation needs, funding requirements and possible co-operation mechanisms in the selected countries. The EU representatives should be scientists, engineers, policy experts, and high-level politicians.
- c) Organize an intergovernmental conference on forestry carbon dioxide emissions as part of future climate policy action, with inputs prepared by scientists, and leading up to policy discussions. The emphasis should be on framework, target, and delimitation issues, and further on to verification challenges.

- d) Develop an action plan together with developing countries to tackle issues where sustainable development and climate change are most strongly linked. Such issues are efficient technologies, security of energy supply (e.g. impact of high oil prices, and electricity shortages), and local air pollution. A first step could be – for instance – to organize a conference on climate policy and energy security.
- e) Stimulate climate policy, energy and technology partnerships with the USA at federal, regional, state, city, town/municipality, and business levels. One idea is to explore linking of regional emission trading initiatives in the USA to EU's emission trading system.
- f) Establish collaboration on development and deployment of renewable energy, such as partnerships with the USA, Russia, China, India, and other interested countries.

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1. Introduction

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), the result of years of intensive international negotiations, is only the first step in combating human-induced climate change. Further action is necessary to reach the ultimate objective of the UNFCCC, i.e. "stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The key issue is how to share this action between all global regions and Parties to the UNFCCC.

Since coming into force in 16 February, 2005, the Kyoto Protocol has set the stage for Annex I Parties to commit themselves to reduce their greenhouse gas emissions in the first commitment period 2008 to 2012 together by five per cent compared to 1990 levels. The Kyoto mechanisms, emission trading, Joint Implementation and the Clean Development Mechanism, play a very important role. Currently, valuable experience is being gathered with the implementation of these mechanisms.

Official negotiations for a second commitment period started in 2005, but as is proving to be the case, these negotiations will be far more complex than the first commitment period. Involving the USA in the current negotiation process will present its own special challenge, certainly from the perspective of moving the current government outside of a GHG intensity reduction mentality to one that assumes an absolute emission reduction target. A variety of positions will also occur within the group of developing countries. This total forms a Gordian knot that will need much creativity to unravel.

In answer to this challenge, this report provides a review of the important issues at hand and recommends pathways for the European Commission to follow during the Post-2012 negotiation process. This has been built upon the work performed in the project's first to third interim reports and supplemental presentations and background notes.

This final report consists of four main themes that are divided into the following chapters:

- **Country Groupings:** This chapter provides a review of country groupings with respect to *national criterion* (such as existing country categorisations, greenhouse gas intensities on a per capita and per GDP level, and the ability for countries to pay based on GDP/capita and HDI levels) and *national interest* (such as fossil fuel reserves per capita and the contribution of fossil fuel production to the country's GDP or fuel mix). Detail here lays the groundwork for the following sections.
- **Approaches to Future Commitment Negotiations:** This chapter provides an overview and brief assessment of several approaches that have been proposed. These are presented in three groups consisting of a *differentiation of approaches* (methods to differentiate between countries in e.g. the time and form of participation or the stringency of their efforts), *types of action* (emission reduction actions that a country could take on) and *other approaches* (such as setting national and cross-national targets, procedural approaches, and extensions of agreements).
- **Elements of a Possible Future Regime:** This chapter details four main elements that will most likely make up a future agreement: a) the setting, differentiation, and development of future emission reduction commitments through the *multi-stage approach*; b) reaching agreement on *adaptation*; c) reaching agreement on *land-use change and forestry* emissions; and issues related to reaching agreement on *technology*. A number of options within each element will be explored with the final section selecting elements that will prove most conducive to the negotiation process while still retaining environmental effectiveness.
- **Outline of a possible negotiation process:** This final chapter presents a review of negotiation scenarios, followed by an analysis of organization and sequencing of negotiations. Next the building of alliances with key partners is explored, and ways the EU can demonstrate leadership throughout the process is discussed. Finally, a list of elements in EU's climate

negotiation strategy that should be emphasised is presented, followed by an additional list of short-term actions that are proposed.

Meeting the long-term goal that “global average temperatures should not exceed 2 Celsius above pre-industrial levels” will prove a significant challenge. It is hoped that the elements prescribed in this report will assist the European Union in rising to the task at hand and facilitate agreement for a Post-2012 climate change regime.

2. Country groupings

I. Introduction

An important issue in international climate negotiations is which countries should take up mitigation commitments after 2012. The aim of this chapter is to present relevant country groupings without entering into the discussion of what character further commitments should take.

Results are based on year 2000 data; it is assumed that rankings provided in this report will not change significantly in the short-term although the emissions share between countries is expected change.

An often-used categorisation criterion is per capita greenhouse gas emissions. This criterion best reflects the current distinction between Annex I and Non-Annex I countries and this is where our initial review begins. As will be shown, the cut-off is about 5.0 tonnes CO₂-eq per capita for energy-related CO₂ emissions and about 7.0 tonnes CO₂-eq per capita for all greenhouse gases excluding land-use change emissions, but there are some exceptions. If land-use change emissions are included, the separations become even less distinct.

Per capita emissions of greenhouse gases (excluding land-use change) forms a good starting point for future commitment selection criterion. Further to this we review individual country greenhouse gas emissions on a per GDP_{ppp} level and issues related to financing requirements of a carbon constrained world. Many members of G77 and China stress that while climate change is important, national situations necessitate a focus on poverty reduction and economic growth rather than reducing greenhouse gas emissions

Finally, we review the importance of existing fossil fuel reserves for national economies and energy supply. An overview of the present fossil fuel reserves is given as well as the financial value of fossil fuel production for each country. Finally we review the contribution of each fossil fuel to a country's total primary energy supply.

This information lays the groundwork for country groupings proposed in the multi-stage section in Chapter 4.

II. Criterion Based

i. Introduction

This chapter begins with an examination of existing country grouping methodologies. Official groups in the UNFCCC will be reviewed, as will other political country groups involved in UNFCCC negotiations – such as the G77 and China – and groups involved in agreements outside of the UNFCCC.

Attention is then focussed on understanding which countries could take up mitigation commitments after 2012 based on a number of relevant indices. Categorisation criteria are based on comparing greenhouse gas emissions on a per capita level as well as on a per GDP level. Comparisons including and excluding land-use change will also be reviewed. The world's top twenty greenhouse gas emitting countries will be highlighted throughout our analysis, but attention will also be paid to a number of other unique countries and country groupings. Apart from greenhouse gas emissions, countries' potential "ability to pay" for emissions mitigation efforts will also be addressed.

Investigation will also be made into a number of countries' fossil fuel dependencies, both on an energy supply and economic level which completes the picture in terms of which country groupings are relevant and the countries that are of most interest in addressing climate change.

It should also be noted that data used throughout our analyses are taken from the World Resources Institute's Climate Analysis Indicators Tool (CAIT) version 1.5 with the year 2000 being our reference year. As a result, before entering international discussions on greenhouse gas mitigation, national

data sources, such as emission inventory submissions to the UNFCCC, may need to be taken into account. And finally, all GDP figures used in our analysis take into account purchasing power parities.

ii. Existing country groupings

Official groups in the UNFCCC: Annex I / Annex II / Economies in transition / Annex B

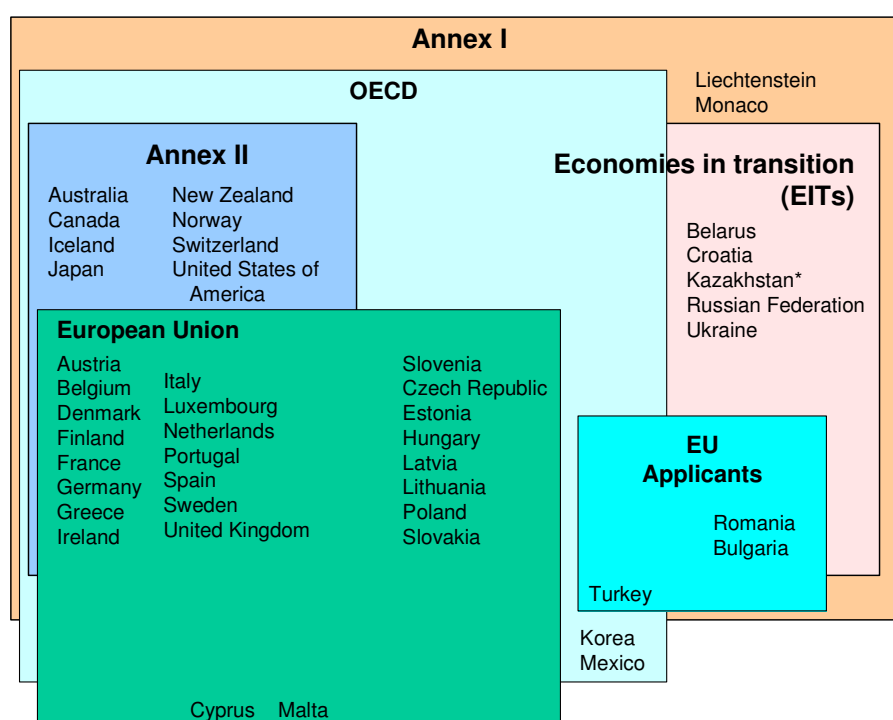
The UNFCCC builds upon the principle of common but differentiated responsibilities and capabilities of Parties. Accordingly, for the purpose of differentiating the obligations or commitments under the Conventions (and later the Kyoto Protocol), countries are divided into three groups (see also Table 1 and Figure 1):

Parties included in Annex II to the Convention encompass the countries that were members of the Organization for Economic Co-operation and Development (OECD) in 1992.

Parties included in Annex I to the Convention (Annex I Parties) encompass both the countries that were members of the Organization for Economic Co-operation and Development (OECD) in 1992, and countries with "economies in transition" (EITs), that is, the Russian Federation and several other Central and Eastern European countries.

Parties not included in Annex I to the Convention (Non-Annex I Parties) encompass those countries that are not member of Annex I, including all newly industrialized countries and developing countries.

While the "Annex I" was used in the Convention as a vehicle to differentiate the commitments related to only one Article, the division between Annex I and Non Annex I Parties has developed since into a very rigid divide. With the Kyoto Protocol, this division has been further manifested. The Kyoto Protocol did not define a new group of countries (sometimes referred to as "Annex B Parties"), it rather updated Annex I by adding those countries that applied to be included and those whose geographical borders changed as well as deleting those that had not ratified the Convention at the time of adoption of the Kyoto Protocol.



*: Added to Annex I only for the purpose of the Kyoto Protocol at COP7

Figure 1: Developed country groups and their G77 & China counterparts

Table 1: Members of Annex I and their commitment under the Kyoto Protocol

Country	Member of Annex I	Member of Annex II	Economy in transition	Commitment inscribed in Annex B (in the EU burden sharing agreement)
Australia	X	X		108
Austria	X	X		92 (87)
Belarus	X		X	****
Belgium	X	X		92 (92.5)
Bulgaria	X		X	92
Canada	X	X		94
Croatia	X*		X	95
Czech Republic	X*		X	92
Denmark	X	X		92 (79)
Estonia	X		X	92
European Community	X	X		92
Finland	X	X		92 (100)
France	X	X		92 (100)
Germany	X	X		92 (79)
Greece	X	X		92 (125)
Hungary	X		X	94
Iceland	X	X		110
Ireland	X	X		92 (113)
Italy	X	X		92 (93.5)
Japan	X	X		94
Kazakhstan	X**		X	To be negotiated
Latvia	X		X	92
Liechtenstein	X*			92
Lithuania	X		X	92
Luxembourg	X	X		92 (72)
Monaco	X*			92
Netherlands	X	X		92 (94)
New Zealand	X	X		100
Norway	X	X		101
Poland	X		X	94
Portugal	X	X		92 (127)
Romania	X		X	92
Russian Federation	X		X	100
Slovakia	X*		X	92
Slovenia	X*		X	92
Spain	X	X		92 (115)
Sweden	X	X		92 (104)
Switzerland	X	X		92
Turkey	X	***		****
Ukraine	X		X	100
United Kingdom	X	X		92 (87.5)
United States of America	X	X		93

*: Added to Annex I at the third conference of the Parties in Kyoto 1997 (COP 3)

** : Added at COP7 only for the purpose of the Kyoto Protocol (see FCCC/CP/2001/13/Add.4, section V.C)

***: Deleted from Annex II by decision 26/CP.7. Turkey now has acceded to the Convention (Feb. 2004)

****: No limit specified. Country had not ratified the Convention when Kyoto Protocol was adopted

Several countries are of interest due to changes in their membership to certain groups:

Kazakhstan is a Party included in Annex I for the purpose of the Kyoto Protocol, since it made the required notification, but will continue to be a Party not included in Annex I for purposes of the Convention, since this requires a decision of the COP. A reduction target for the Kyoto Protocol has to be defined.

Turkey was deleted from Annex II upon its request and has now acceded to the UNFCCC. A reduction target for the Kyoto Protocol has to be defined.

Cyprus and Malta joined the EU, but are not members of Annex I. They can make the notification to join Annex I for the purpose of the Kyoto Protocol and COP will need to agree to include them on Annex I for the purpose of the Convention.

South Korea and Mexico have joined the OECD after the adoption of the UNFCCC and were therefore not automatically included in Annex I.

Political developing country groups in the UNFCCC negotiations

G77 and China: Developing countries generally negotiate in the United Nations through the Group of 77 and China with a common negotiating position. The G-77 was founded in 1964 in the context of the UN Conference on Trade and Development (UNCTAD) and now functions throughout the UN system, comprising over 130 members. The interests of the member of the G-77 and China are diverse (including e.g. small island states and oil exporting countries at the same time), but the group has in the past often negotiated with one voice to better position itself vis a vis developed countries. G77 and China comprised 53% of total greenhouse gas emissions in 2000 (WRI 2003).

Least developed countries (LDCs): The 48 countries defined as Least Developed Countries by the UN regularly work together in the wider UN system. Membership to this group is by self-identification. The group of least developed countries has a special status under the Convention. LDCs comprised 6% of global greenhouse gas emissions in 2000 (WRI 2003). The top five GHG emitting countries within this group consists of Myanmar, The Democratic Republic of Congo, Zambia, Nepal, and Sudan.

Alliance of Small Island States (AOSIS): AOSIS is a coalition of some 43 low-lying and small island countries and territories, most of which are members of the G-77, that are particularly vulnerable to sea-level rise. The AOSIS countries are united by the threat that climate change poses to their survival. AOSIS comprised 1% of global greenhouse gas emissions in 2000 (WRI 2003).

Organization of Petroleum Exporting Countries (OPEC): Oil exporting countries have special common interests in the UNFCCC. They however rarely officially act as a group under the UNFCCC. OPEC comprised 12% of global greenhouse gas emissions in 2000 (WRI 2003).

Groups in other international agreements

Montreal Protocol: The Montreal Protocol for the protection of the ozone layer differentiates two distinct groups of Parties: Industrialized countries and those developing countries operating under Article 5(1) of the Montreal Protocol. The latter group includes Parties to the Montreal Protocol with an annual calculated level of consumption less than 0.3 kg per capita of the controlled substances in Annex A and less than 0.2 kg per capita of the controlled substances in Annex B, on the date of the entry into force of the Montreal Protocol, or any time thereafter. The two groups have different phase-out schedules for the production and consumption of ozone depleting substances. "Article 5(1) countries" can apply for funding under the multilateral fund of the Montreal Protocol (UNEP 2003).¹

The definition of "developing country" in a dynamic way is a distinct advantage of the Montreal Protocol over the UNFCCC, as it does not require decisions for updating country lists. Under the UNFCCC increasing Annex I has not been possible in the past, as it required the consensus decision by

¹ United Nations Environment Programme (UNEP) 2003, Handbook for the International Treaties for the Protection of the Ozone Layer, Secretariat for The Vienna Convention for the Protection of the Ozone Layer & The Montreal Protocol on Substances that Deplete the Ozone Layer, Kenya, available at <http://www.unep.org/ozone>

the COP. Were Annex I defined using a threshold of e.g. emissions per capita, this problem would not have occurred.²

The group Article 5(1) countries under the Montreal protocol is very similar to the group of Non-Annex I countries under the UNFCCC (Differences: Croatia, Turkey and Romania are members of Annex I but are also Article 5(1) countries).

World Trade Organization (WTO): The WTO also divides countries in "developed" and "developing" countries. No WTO definitions are available, members rather announce for each individual agreement under the WTO whether they are "developed" or "developing" countries. Other members can challenge the decision of a member to make use of provisions available to developing countries. In some WTO agreements, these provisions provide developing countries with longer transition periods before they are required to fully implement the agreement. Developing countries can also receive technical assistance. The WTO also recognises the UN Least Developed Countries group.³

iii. Greenhouse Gas Intensity Country Groupings

Two methods of comparing countries' greenhouse gas emissions will be reviewed – on a per capita and a GDP basis. Focus will be placed on the twenty most GHG emitting countries as well as Annex I and Non-Annex I members. GHG scenarios will include emissions from only energy-related CO₂ emissions, GHG without LULUCF and GHG including LULUCF. Data used throughout our analysis are taken from the World Resources Institute's Climate Analysis Indicators Tool (CAIT) version 1.5 with the year 2000 being our reference year.

Per Capita Comparisons

Figure 2 on the following page graphs countries' energy-related CO₂ per capita emissions (ranked on a descending per capita basis) versus their share of world GHG emissions. Figure 3 and Figure 4 repeat this analysis but instead examine GHG per capita emissions excluding and including LULUCF respectively.

As can be seen from the top twenty GHG emitting countries highlighted in Figure 2 and Figure 3, country rankings in both the energy-related CO₂ and GHG (excluding LULUCF) analyses remain quite comparable, certainly when looking at the world's top twenty GHG emitting countries.

There are some exceptions though as China ranks before Brazil in energy-related CO₂ per capita emissions but not so when looking at GHG per capita emissions excluding LULUCF. In fact, of the top twenty GHG emitting countries, Brazil, the Ukraine and Australia all move significantly up in rank, showing their emissions are more heavily influenced by non-CO₂ sources than other countries.

Countries with the highest per capita emissions, found to the right of the graphs, are seen to be primarily Annex I countries.

In the year 2000, Annex I countries were responsible for:

- 59% of energy-related CO₂ emissions
- 52% of GHG emissions (excluding LULUCF)
- 42% of GHG emissions (including LULUCF)

Most Annex I countries have a energy-related CO₂ per capita emission levels greater than 5.0 tonnes and in the case of total GHG, most emit more than 7.0 tonnes CO₂-eq per capita. There are a few exceptions, but only for a handful of countries; Croatia, Romania, Turkey, Lithuania, and Latvia are Annex I countries with energy-related CO₂ per capita emissions less than 5 tonnes per capita and GHG excluding LULUCF per capita emissions less than 7 tonnes.

² United Nations Environment Programme (UNEP) 2003, Handbook for the International Treaties for the Protection of the Ozone Layer, Secretariat for The Vienna Convention for the Protection of the Ozone Layer & The Montreal Protocol on Substances that Deplete the Ozone Layer, Kenya, available at <http://www.unep.org/ozone>

³ World Trade Organization, 2002, web site, http://www.wto.org/english/tratop_e/devel_e/d1who_e.htm

CO₂ (Energy) Per Capita Emissions

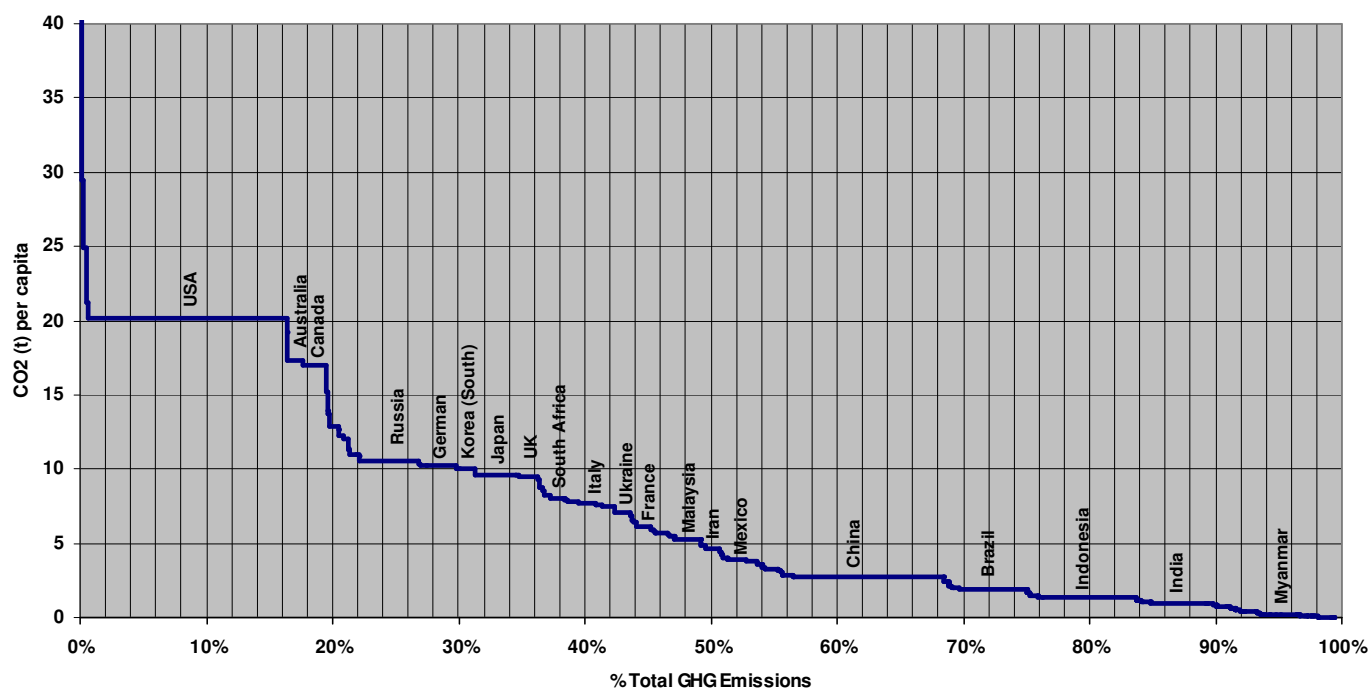


Figure 2: Energy-related CO₂ per capita emissions highlighting the twenty most GHG emitting countries (CAIT v1.5, 2000)

GHG (excluding LUC) Per Capita Emissions

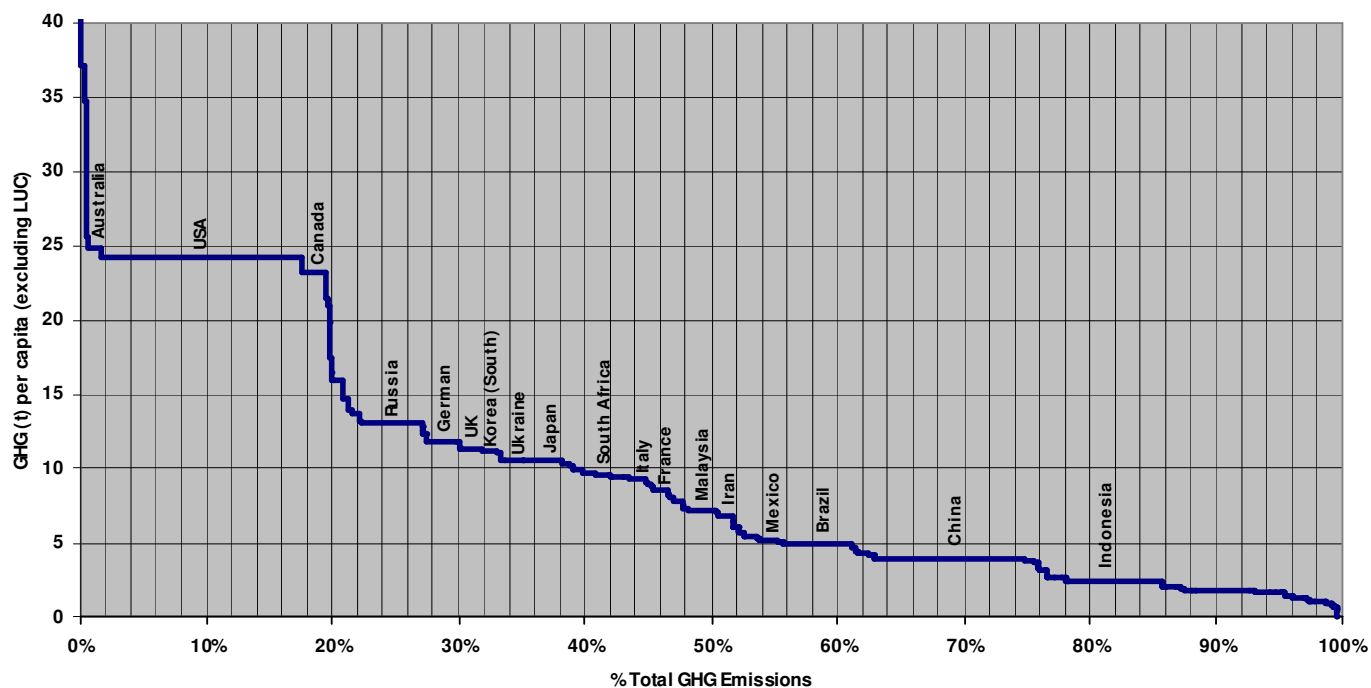


Figure 3: GHG excluding LULUCF per capita emissions highlighting the twenty most GHG emitting countries (CAIT v1.5, 2000)

There are also a number of Non-Annex I countries with emission levels similar to Annex I countries – i.e. those with energy-related CO₂ per capita emissions greater than 5.0 tCO₂ and/or GHG excluding LULUCF per capita emissions greater than 7.0 tCO₂-eq. Among these, a number of country groupings present themselves and have been divided into the following three groups:

Major oil exporting countries:⁴ comprising to 2.7% of the world's energy-related CO₂ emissions and 2.5% of the world's GHG emissions including LULUCF (Table 2)

Former Soviet Union countries: comprising to 8.0% of the world's energy-related CO₂ emissions and 7.8% of the world's GHG emissions including LULUCF (Table 3)

Rapidly industrialising countries: comprising 6.4% for both the world's energy-related CO₂ emissions and GHG emissions including LULUCF (Table 4)

A number of other countries including Botswana, Cyprus, Israel and Korea (North) also have more than 7 tCO₂-eq. Their total emissions are small when compared to the above three groups.

Table 2: Major oil exporting countries with emission levels similar to Annex I countries (for completeness (data on oil exporting countries with emissions less than 5.0 tCO₂-eq per capita are also provided)

Country	GHG with LULUCF (MtCO ₂ -eq)	Per capita energy-related CO ₂ emissions (tCO ₂ /capita)	Per capita GHG emissions without LULUCF (tCO ₂ -eq/capita)
Qatar	40	60.0	67.9
United Arab Emirates	108	24.9	37.1
Kuwait	69	29.5	34.7
Bahrain	17	21.3	25.6
Brunei	7	13.7	21.3
Saudi Arabia	330	12.8	15.9
Oman	30	10.4	12.3
Libya	55	8.0	10.3
Venezuela	385	5.7	10.0
Iran	447	4.7	6.9
Algeria	115	2.4	3.7
Indonesia	3058	1.4	2.4
Nigeria	357	0.4	1.3
Iraq	100	3.4	4.3

Table 3: Former Soviet Union countries with emission levels similar to Annex I countries

Country	GHG with LULUCF (MtCO ₂ -eq)	Per capita energy-related CO ₂ emissions (tCO ₂ /capita)	Per capita GHG emissions without LULUCF (tCO ₂ -eq/capita)
Turkmenistan	62	6.5	11.8
Kazakhstan	159	8.2	10.6
Uzbekistan	181	4.9	7.3

⁴ Note that OPEC countries having per capita emissions less than the majority of Annex I countries are still included in Table 2. These include Iran, Iraq, Algeria, Indonesia and Nigeria and are not included the groups share of world GHG emissions.

Table 4: Rapidly industrialising countries with emission levels similar to Annex I countries

Country	GHG with LULUCF (MtCO ₂ -eq)	Per capita energy-related CO ₂ emissions (tCO ₂ /capita)	Per capita GHG emissions without LULUCF (tCO ₂ -eq/capita)
Singapore	64	15.2	16.0
Korea (South)	527	10.0	11.2
Taiwan	230	10.2	10.4
South Africa	415	8.1	9.7
Korea (North)	210	7.6	9.4
Argentina	345	3.8	7.8
Malaysia	867	5.3	7.2

Looking at the top per capita countries with respect to energy-related CO₂ emissions (Figure 2), it is interesting to note that approximately 56% of the world's total GHG emissions are taken into account before coming to China. China's energy-related CO₂ per capita emissions (2.8 tCO₂/capita) are about 14% of the US figure and sit well below the world's average energy-related CO₂ per capita emissions, approximately 4.0 tCO₂/capita. The same situation can be seen in Figure 3 when looking at per capita GHG emissions excluding LULUCF although here approximately 62% of the world's total GHG emissions are taken into account before reaching China.

Non-Annex I Countries having per capita GHG emissions (excluding LULUCF) greater than China, but nearing the minimum per capita emission levels of most Annex I countries (again 7.0 tCO₂-eq per capita) are summarised in Table 5. These countries comprise 5.0% of the world's energy-related CO₂ emissions and 9.7% of the world's GHG emissions including LULUCF.

Table 5: Non-Annex I countries approaching Annex I country per capita GHG emission levels (excluding LULUCF)⁵

Country	GHG including LULUCF (MtCO ₂ -eq)	GHG excluding LULUCF (MtCO ₂ -eq)	Per capita energy-related CO ₂ emissions (tCO ₂ /capita)	Per capita GHG emissions excluding LULUCF (tCO ₂ -eq/capita)
Namibia	13	11	1.1	6.1
Gabon	11	7	1.2	5.8
Cambodia	125	69	0.0	5.7
Serbia & Montenegro	61	61	4.2	5.7
Macedonia, FYR	11	11	4.4	5.5
Belize	23	1	3.4	5.3
Azerbaijan	42	42	3.7	5.3
Mexico	608	511	3.9	5.2
Mauritania	14	14	1.2	5.2
Chile	92	77	3.6	5.1
Guyana	39	4	2.1	5.1
Jamaica	16	13	4.0	5.0
Paraguay	47	26	0.7	5.0
Brazil	2213	841	1.9	4.9

⁵ Although the country of Vanuatu is part of this list, it has not been included given its low total GHG emissions (less than 1 million tonnes in GHG emissions per year)

Country	GHG including LULUCF (MtCO ₂ -eq)	GHG excluding LULUCF (MtCO ₂ -eq)	Per capita energy-related CO ₂ emissions (tCO ₂ /capita)	Per capita GHG emissions excluding LULUCF (tCO ₂ -eq/capita)
Jordan	24	24	3.2	4.9
Bolivia	123	39	1.4	4.7
Cuba	41	50	2.8	4.5
Syria	71	71	3.2	4.4
Thailand	309	261	2.8	4.3
Bosnia & Herzegovina	17	17	3.6	4.2
Lebanon	19	18	3.6	4.2
Panama	59	12	2.0	4.1

In all of our above analyses, we have concentrated on energy-related CO₂ and GHG excluding LULUCF emissions. A number of substantial changes are seen when reviewing GHG including LULUCF though (Figure 4) and these will now be brought into the discussion.

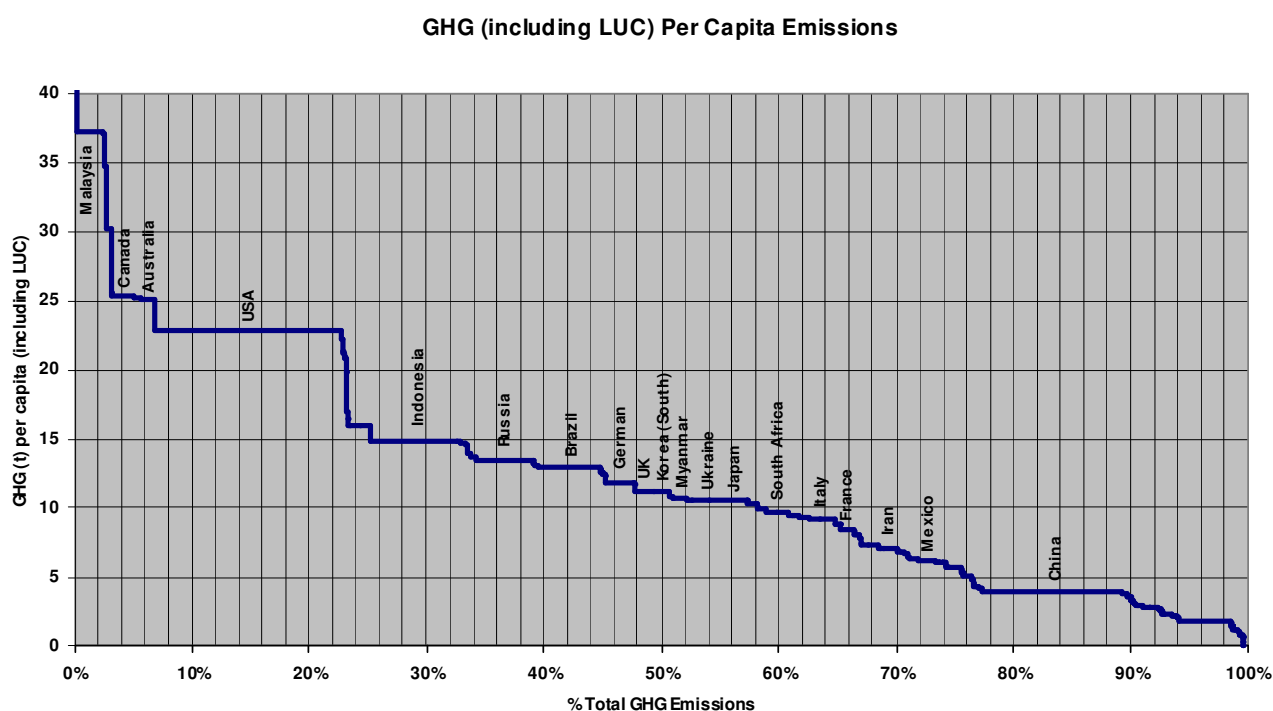


Figure 4: GHG (including LULUCF) per capita emissions highlighting the twenty most GHG emitting countries (CAIT v1.5, 2000)

Comparing the inclusion of LULUCF to where GHG excluding LULUCF are examined (Figure 4 versus Figure 3), we see some countries have negative CO₂ emissions with respect to land use changes. The USA is one of the countries achieving a drop in GHG/capita emissions through its negative emissions from land use change in 2000 according to the data source used.

Most countries though show an increase in per capita GHG emissions when LULUCF is taken into account. The most significant of these increases occur in countries such as Malaysia, Indonesia, Brazil and Myanmar, having their per capita emissions by a factor of about 2.5 (Brazil) to 7 (Myanmar).

Furthermore, there are a number of countries that have less than 7 tonnes GHG per capita excluding LULUCF but more than 7 tonnes GHG per capita when including LULUCF. A number of others have their GHG including LULUCF per capita levels increase by 20% or more over GHG per capita levels excluding LULUCF. The twenty largest GHG emitters from this group are detailed in Table 6. These countries account for approximately 24% of world GHG emissions.

The following figure presents the world share of greenhouse gas emissions (including LULUCF) as per-capita emission cut-off levels decrease.

Table 6: Non-Annex I countries showing significantly high GHG per capita emissions if LULUCF emissions are included (i.e. countries with less than 7 tonnes GHG per capita excluding LULUCF but more than 7 tonnes GHG per capita when including LULUCF or show a 20% increase)

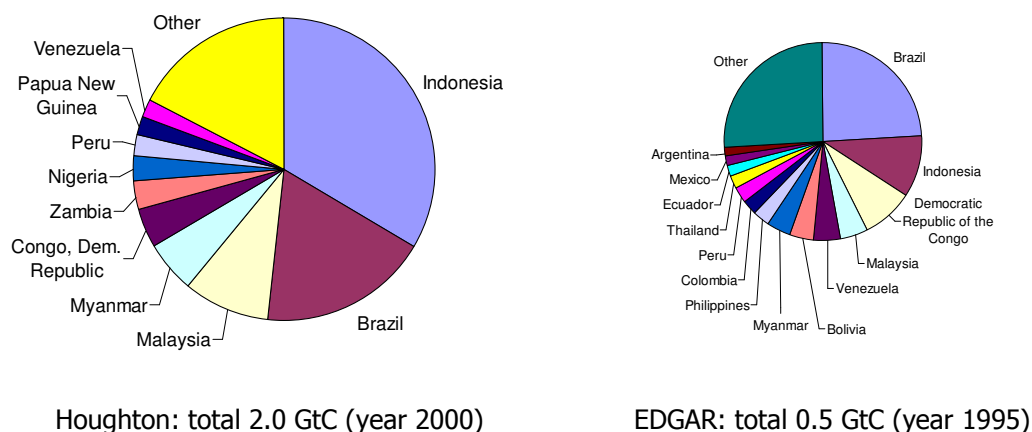
Country	GHG without LULUCF (MtCO ₂ -eq)	GHG with LULUCF (MtCO ₂ -eq)	Per capita GHG emissions without LULUCF (tCO ₂ -eq/capita)	Per capita GHG emissions with LULUCF (tCO ₂ -eq/capita)
Indonesia	495	3058	2.4	14.8
Brazil	841	2213	4.9	13.0
Malaysia	168	867	7.2	37.3
Myanmar	82	508	1.7	10.6
Venezuela	241	385	10.0	15.9
Congo, Dem. Republic	53	370	1.0	7.3
Nigeria	163	357	1.3	2.8
Colombia	161	267	3.8	6.3
Peru	70	257	2.7	9.9
Zambia	19	254	1.8	25.2
Philippines	131	226	1.7	2.9
Papua New Guinea	9	155	1.7	30.1
Nepal	31	154	1.3	6.7
Sudan	100	130	3.2	4.2
Cambodia	69	125	5.7	10.4
Bolivia	39	123	4.7	14.7
Côte d'Ivoire	17	108	1.0	6.7
Cameroon	27	104	1.8	7.0
Ecuador	40	99	3.1	7.8

Caution should be placed in including LULUCF into our analyses though. Accuracy of data⁶ can be a challenge and the effect land use changes have on countries is highly dependent upon data source and the reference year. That being said, opportunities for improved forestry and land use management are interesting for countries like Malaysia, Indonesia, Brazil and Myanmar – perhaps an opportunity to leverage existing development and climate change funds in exchange for guarantees on achieving specific land-use change goals.

Comparing the range between two trusted sources on LULUCF emissions shows the challenge in assembling concise data. Figure 5 compares LULUCF data from Houghton (2003) to EDGAR (2000).

⁶ Land use change in our analyses is taken from the World Resources Institute's Climate Analysis Indicators Tool (CAIT) version 1.5 which in turn relies on Houghton, R.A. 2003. "Emissions (and Sinks) of Carbon from Land-Use Change."

Figure 5: Magnitude of global emissions from land use change, a subcategory of LULUCF, (for comparison: global fossil fuel emissions ~ 6 GtC)



iv. Greenhouse Gas Emissions Per GDP Comparisons

Figure 6 to Figure 8 on the following pages compare individual country energy-related CO₂, GHG (excluding LULUCF) and GHG (including LULUCF) emissions on a per GDP_{PPP} level.

As can be seen, there is relatively little difference in country-order when reviewing the world's top twenty GHG emitters on an energy-related CO₂ and GHG (excluding LULUCF) level. Some of the most significant changes occur with countries like Myanmar, Indonesia, Malaysia, Brazil and Indonesia.

Looking back to our analyses comparing GHG emissions on a per capita basis, there are very significant changes. Both Annex I and non-Annex I countries are distributed throughout the graph; their rankings become quite intermixed.

This mixed distribution is due to a number of reasons – industrial and energy efficiencies, type of industries present, climatic situations, etc. – and as a result makes such a metric difficult to utilise in signing on non-Annex I countries to binding GHG emissions targets. What can be concluded though is that:

- Russia and a number of its former satellite states have some of the highest GHG per GDP ranks
- a number of Non-Annex I developing countries, such as China and Iran, have high GHG per GDP level and are part of the countries that assume the first half of the world's GHG emissions
- countries in the EU tend to score comparatively low in GHG per GDP and as a result appear to the right of the graphs

Countries with high greenhouse gas emissions per GDP include:

- Zambia (33 ktonnes per million \$US GDP)
- Belize (17 ktonnes per million \$US GDP)
- Liberia (12 ktonnes per million \$US GDP)
- Guyana (11 ktonnes per million \$US GDP)
- Papua New Guinea (11 ktonnes per million \$US GDP)

CO₂ (Energy) Per GDP

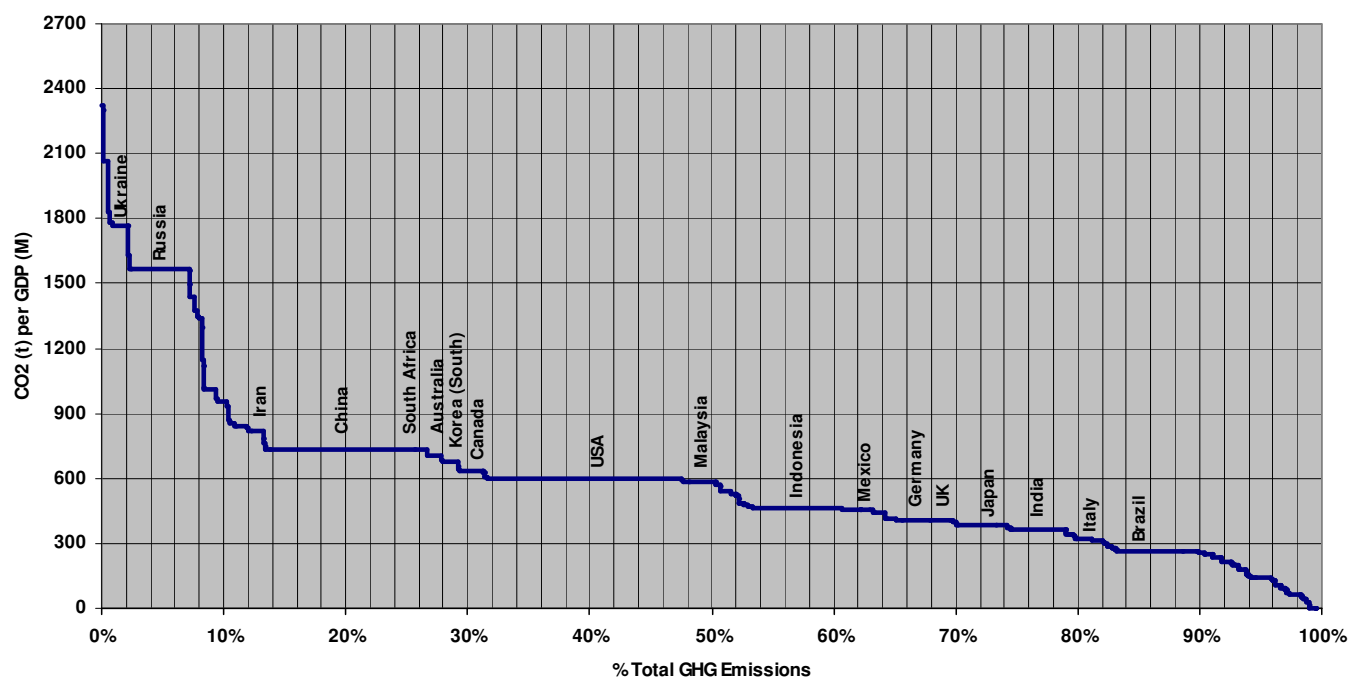


Figure 6: Energy-related CO₂ per GDP (tCO₂/M\$US) highlighting the twenty most GHG emitting countries (CAIT v1.5, 2000)

GHG (excluding LUC) Per GDP

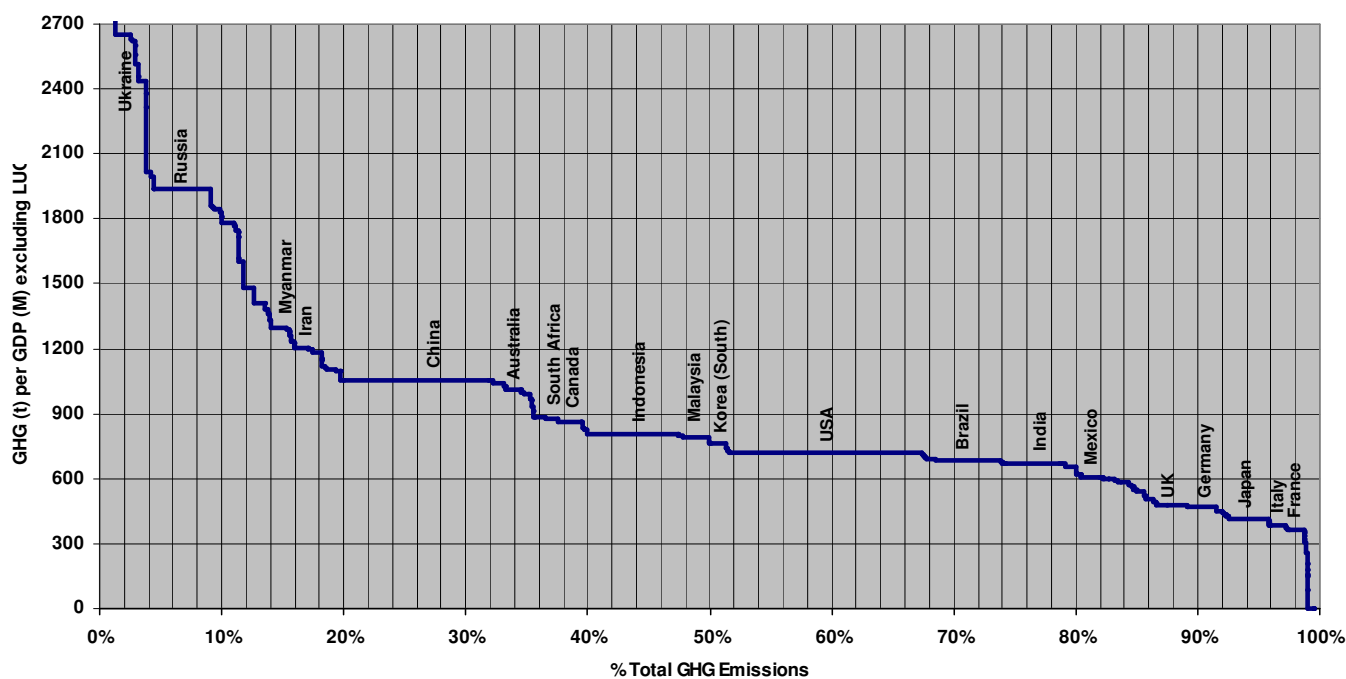


Figure 7: GHG (excluding LULUCF) per GDP (tCO₂-eq/M\$US) highlighting the twenty most GHG emitting countries (CAIT v1.5, 2000)

GHG (including LUC) Per GDP

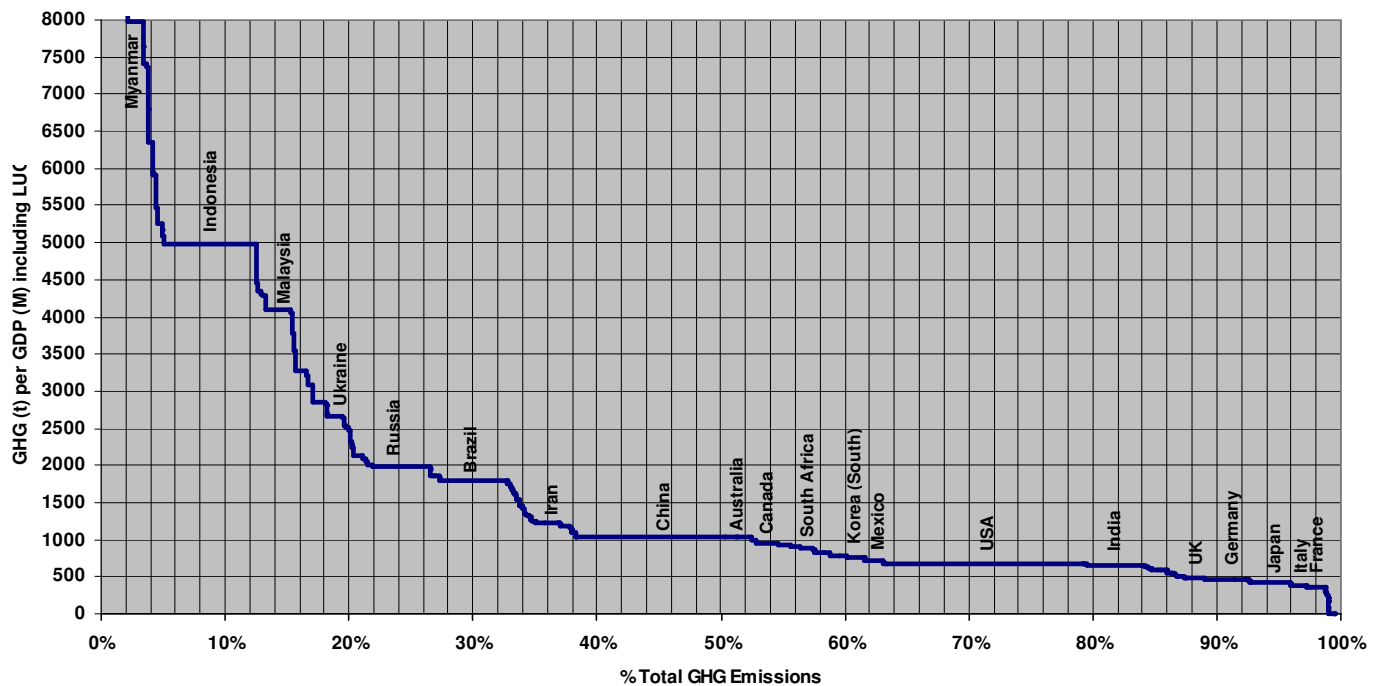


Figure 8: Tonnes GHG (including LULUCF) per GDP ($tCO_2\text{-eq}/M\$US$) highlighting the twenty most GHG emitting countries (CAIT v1.5, 2000)

v. Ability to pay: GDP/capita and HDI

Many members of G77 and China stress that while climate change is important, national situations necessitate a focus on poverty reduction and economic growth rather than reducing greenhouse gas emissions.

In the following pages, we review countries' shares of GHG emissions versus $GDP_{PPP}/capita$ and the Human Development Index (HDI) (Figure 9 and Figure 10).

The World Bank distinguishes four country groupings with respect to GDP per capita. Countries with GDP per capita figures less than \$765 are classified as *low* income countries. The *lower middle* group consists of GDP per capita figures between \$766 and \$3035, the *upper middle* from \$3036 to 9385, and the *high* group at \$9386 or more. Greenhouse gas emission shares for these groups are as follows:

Table 7 GDP per capita groupings and their share of GHG

GDP Category	Share of total GHG	Country examples
Low	1.2%	Democratic Republic of Congo, Tanzania
Lower Middle	22.2%	Indonesia, India, Myanmar
Upper Middle	37.0%	China, Brazil, Russian Federation
High	39.6%	USA, Japan, Germany, Canada

GDP Per Capita Versus Share of GHG Emissions

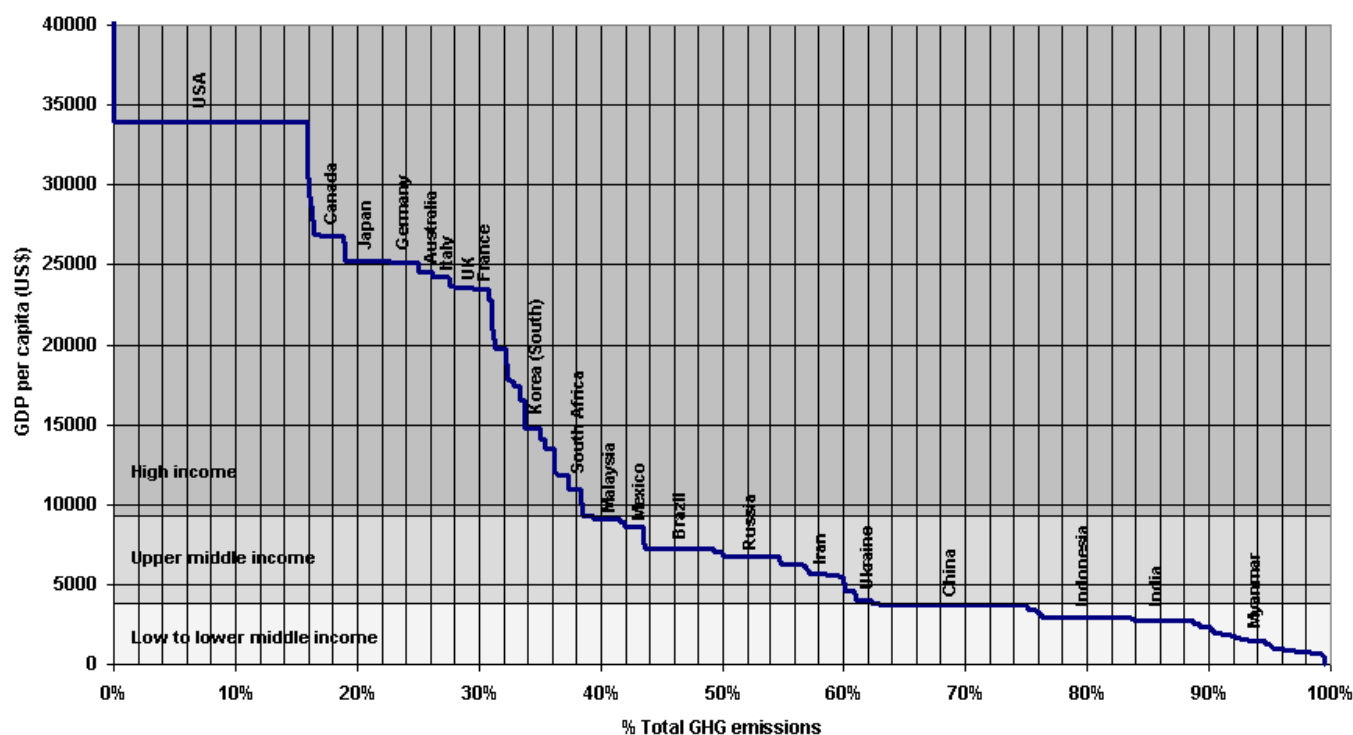


Figure 9: GDP/capita (PPP \$US) versus share of GHG, highlighting the twenty most GHG emitting countries (due to scaling, note the first income band combines both the low to lower to middle income levels) (CAIT v1.5, 2000)

The HDI – human development index – is a summary composite index that measures a country's average status in three basic aspects of human development: longevity, knowledge, and a decent standard of living. Longevity is measured by life expectancy at birth; knowledge is measured by a combination of the adult literacy rate and the combined primary, secondary, and tertiary gross enrolment ratios; and standard of living by GDP_{PPP} per capita.

The greatest greenhouse gas emitting developing countries have some of the lowest per capita incomes, which in turn is reflected in low Human Development Index scores. Note that a High level of human development corresponds to an HDI greater than 0.8, Medium between 0.8 and 0.5, and Low having an HDI less than 0.5. International assistance in greenhouse gas emission programs would well benefit countries with high GHG emissions yet low GDP per capita and/or low HDI scores. Greenhouse gas emission shares for these groups are as follows:

Table 8: HDI groupings and their share of GHG

HDI Category	Share of total GHG	Country examples
Low	6.2%	Democratic Republic of Congo, Nigeria, Pakistan
Medium	53.7%	China, Indonesia, Brazil, Russian Federation
High	40.0%	USA, Japan, Germany, Canada

As expected, Annex I countries lie primarily to the left of the graphs. In fact the top twenty-one countries in the HDI graph are all Annex I countries. These countries also tend to have higher GHG emissions per capita making this analyses similar to per capita analyses.

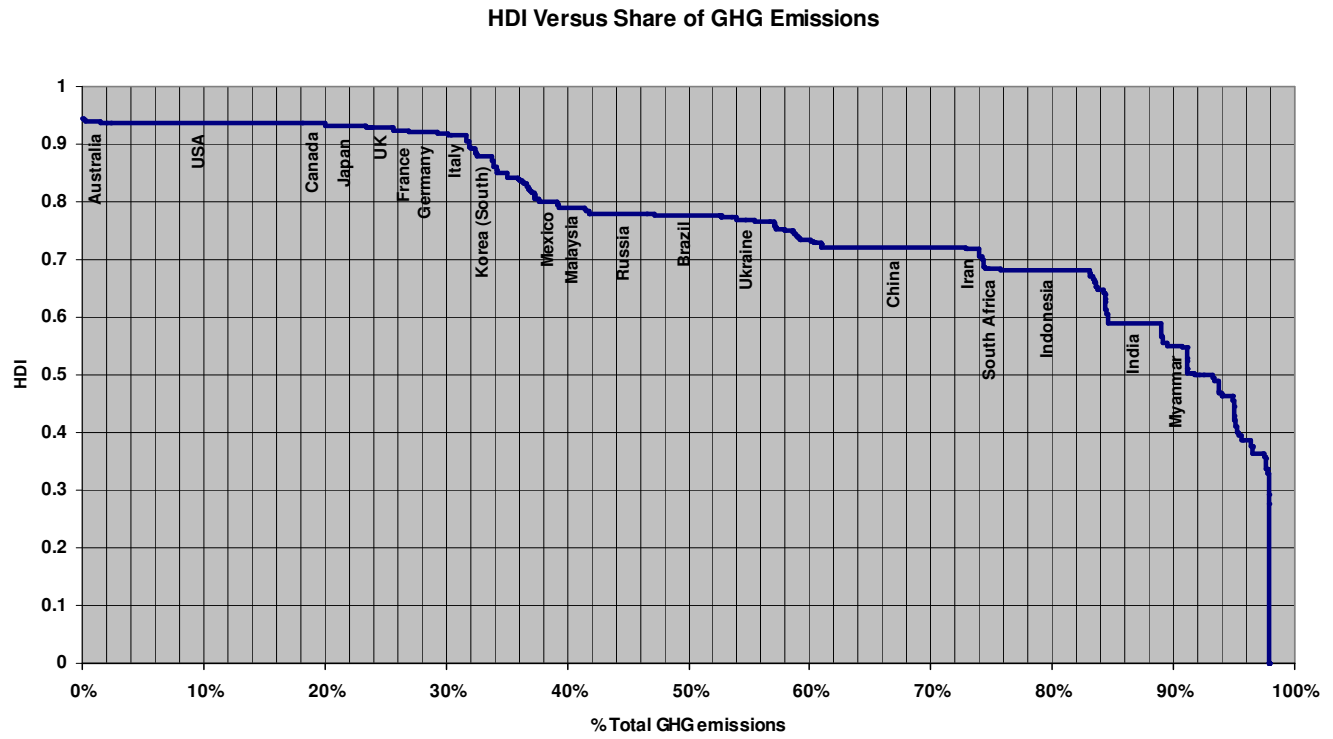


Figure 10: HDI versus share of GHG, highlighting the twenty most GHG emitting countries (CAIT v1.5, 2000)

III. National Interest Based

i. Introduction

This chapter aims to provide insight into the importance of existing fossil fuel reserves for domestic economy and energy supply. First, an overview of the present fossil fuel re-serves is given. Next, per country the financial value of fossil fuel production was examined, as well as the contribution of each fossil fuel to total primary energy supply.

ii. Fossil fuel reserves per capita

Figure 11 below shows the total proved fossil fuel reserves of coal, oil and natural gas per capita versus the total global GHG emissions (including LULUCF). Australia ranks as fourth country on the list with highest fossil fuel reserves per capita, after three oil exporting countries, which are Qatar, Kuwait and the United Arab Emirates. The Australian fossil fuel reserve of around 2300 toe per capita implies a fossil fuel reserve per capita three times higher than in Russia (830 toe/capita), five times higher than in the USA (450 toe/capita) and nearly 50 times higher than in China (50 toe/capita).

There exist nineteen countries with fossil fuel reserves of more than 500 toe per capita. These nineteen countries together are responsible for about 12% of global GHG emissions.

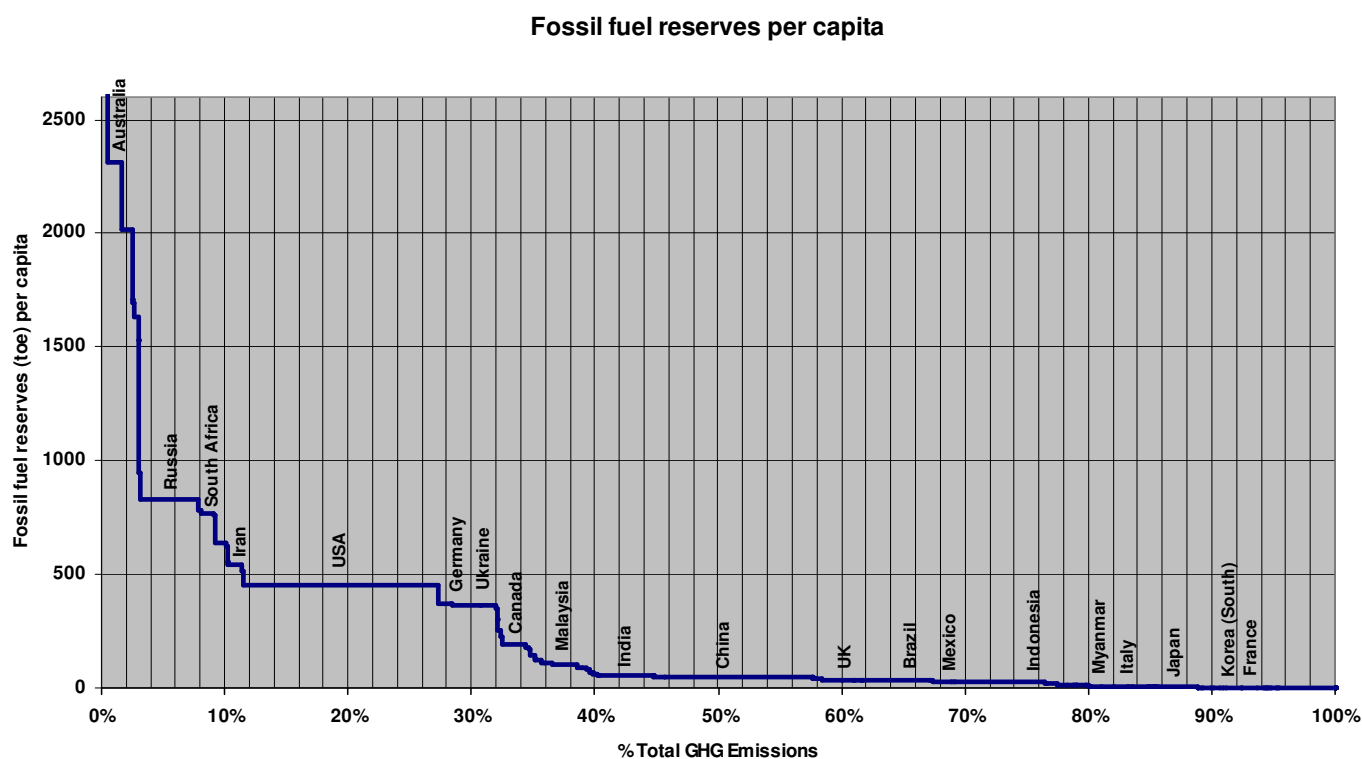


Figure 11: Per capita fossil fuel reserves highlighting the top twenty greenhouse gas emitting countries

iii. Contribution of fossil fuel production to GDP

In order to get insight into the impact of economic benefits of fossil fuel production, the economic value of the production of coal, oil and natural gas was compared with GDP. We calculated the value of the fossil fuel production as share of GDP. Note that these percentages are an indicator for comparison only, as real prices may differ from country to country. Neither show the percentages an exact contribution to GDP, as the revenues from sales are higher than value added, as expressed in GDP.

Value of coal production relative to GDP:

Assuming a single coal price of 40 US\$/ton for all countries, we estimate the value of domestic coal production was up to 2.5% of GDP. Highest relative values of coal production are observed in Kazakhstan (2.5%), Australia (2.5%) and Serbia & Montenegro (2.0%).

Figure 12 shows the value of coal production as share of GDP versus the total global GHG emissions (including LULUCF). For eight countries the value of coal production is more than 1% of GDP. These countries are Kazakhstan, Australia, Serbia & Montenegro, South Africa, Ukraine, Poland, Estonia and Czech Republic. These countries together are responsible for around 5% of the global GHG emissions. For China the value of coal production is currently slightly less than 1% of GDP, while in the case of the United States coal production accounts for 0.4% of GDP.

Value of coal production

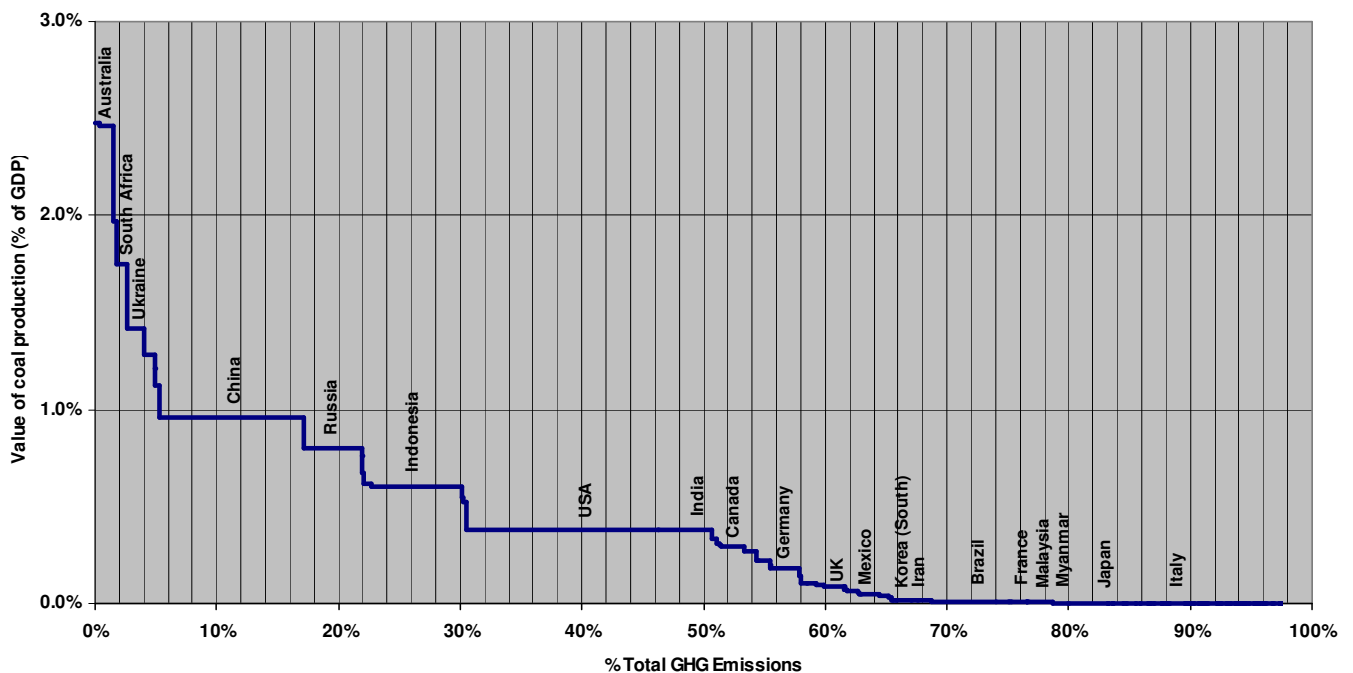


Figure 12: Value of coal production as share of GDP versus the total global GHG emissions

Value of oil production relative to GDP:

To quantify the economic value of domestic oil production, an oil price of 25 US\$ per barrel was assumed for all countries. Values of oil production as high as 83% of GDP for Congo have been observed. After Congo, highest contributions of the oil production are found for Kuwait (50%), Qatar (45%) and Iraq (39%). Figure 13 below shows the value of oil production relative to GDP versus the total global GHG emissions (including LULUCF).

Value of oil production

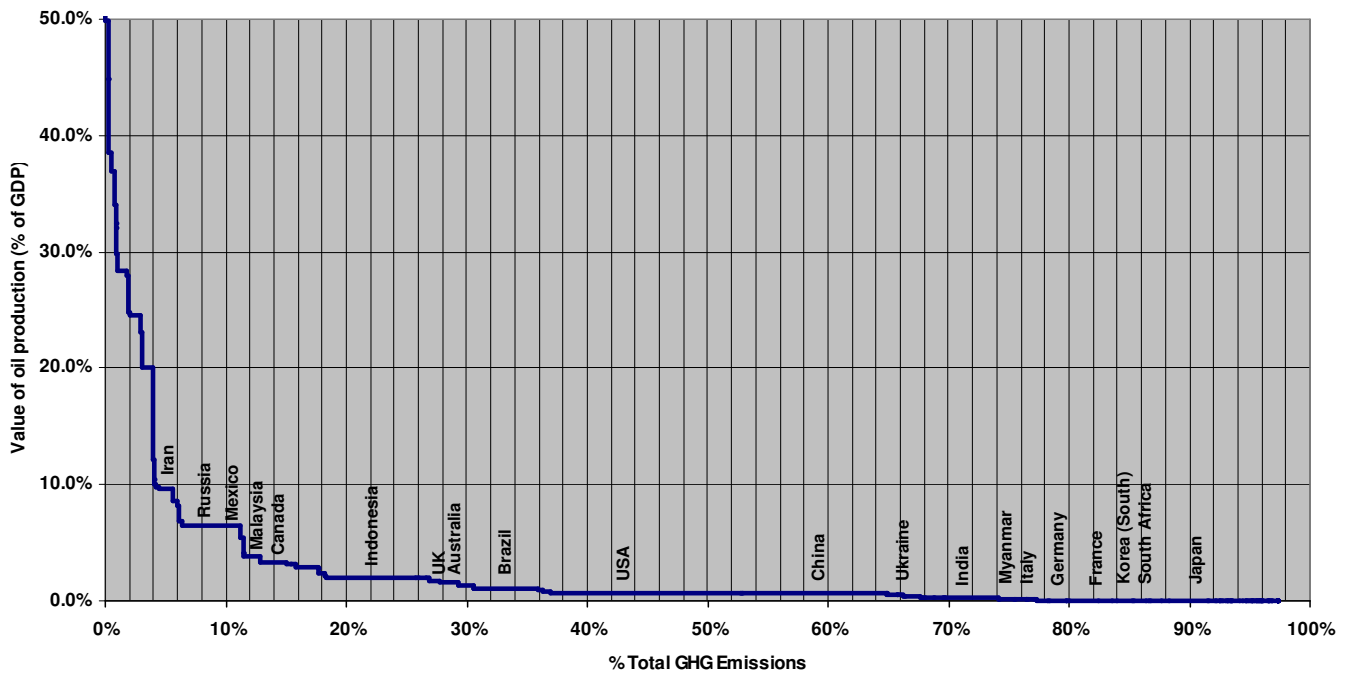


Figure 13: Value of oil production relative to GDP versus the total global GHG emissions

For eighteen countries – mostly OPEC countries – the value of oil production accounts for more than 10% of their GDP. These eighteen countries are together responsible for 4% of global GHG emissions. In the case of Russia, the value of oil production accounts for 6.5% of GDP.

Value of natural gas production relative to GDP:

Assuming a natural gas price of 3 US\$/MBtu for all countries, the contribution of domestic natural gas production to GDP was estimated. Highest value of natural gas production is found in Turkmenistan, which is 26% of GDP. Other countries where the economical benefits of natural gas production play an important role are Qatar (21%), Brunei (19%) and Trinidad & Tobago (12%). Highest Annex I country in this ranking is Russia, where the value of natural gas production accounts for 5.7% of GDP.

For 26 countries domestic the value of natural gas production is for more than 1% of GDP. These 26 countries together emit 24% of global GHG emissions.

Value of natural gas production

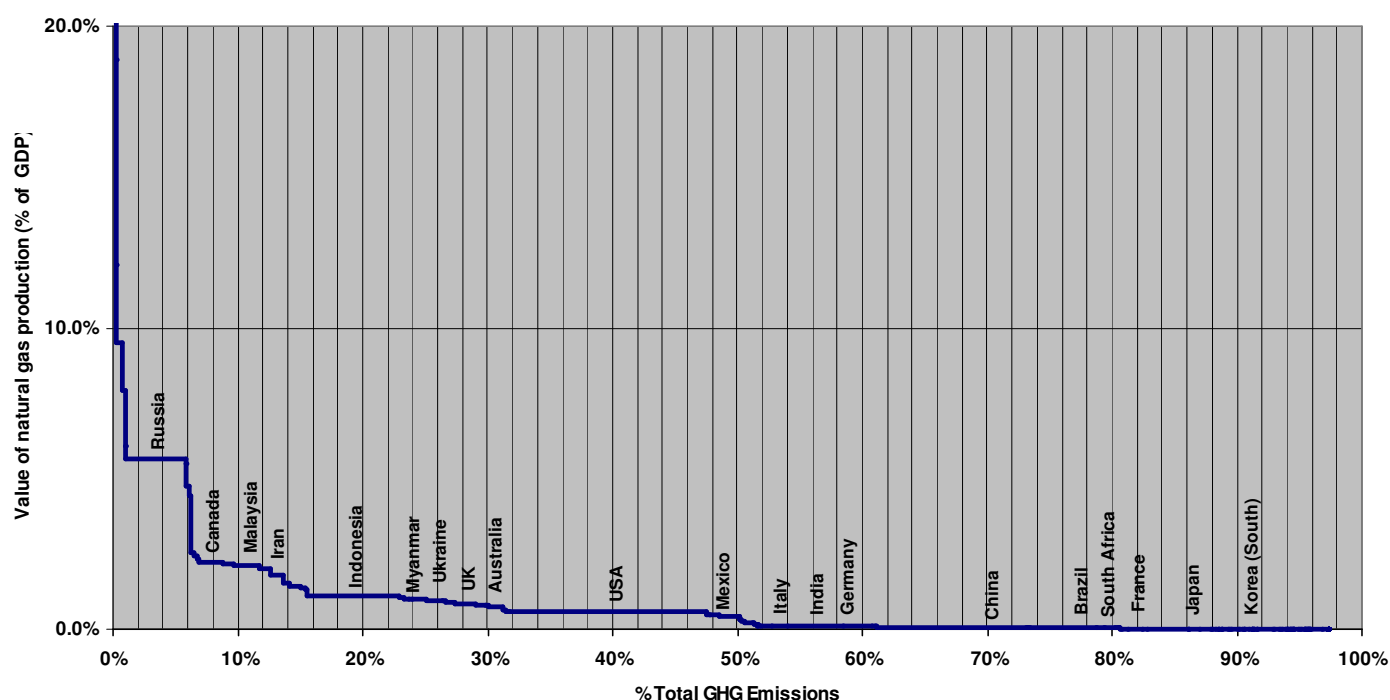


Figure 14: Value of natural gas production relative to GDP versus the total global GHG emissions

iv. Contribution of fossil fuels to fuel mix

In order to get insight into the importance of a specific fossil fuel in the overall fuel mix of a country, the contribution of coal, oil and natural gas to the total domestic energy consumption was estimated. The contribution of coal, oil and natural gas is calculated as the domestic production of each fossil fuel minus exports, divided by total primary energy supply in the same year (2001). Only non-OECD countries have been taken into account.

Contribution of coal production to fuel mix:

Table 9 on the following page shows an overview of countries with highest contribution of coal to their domestic energy consumption.

As can be seen, seven countries have a dependency of more than 50% on coal for their total domestic energy consumption. Most of these countries have very few fossil fuel reserves apart from coal. In North Korea coal counts for 84% of the total energy consumption, while the country does not exploit oil or natural gas at all. The share of coal in the fuel mix of China is 55%, while for India the contribution of domestic coal to the fuel mix is 31%.

Note that as import is not taken into account, some negative numbers can appear. This occurs when a country exports fuel (derivates) for which the fuel does not come from domestic production but first had to be imported.

Table 9: Non-OECD countries with a contribution of domestic coal of more than 50% to the overall domestic energy consumption (ktoe/ktoe)⁷

Country ⁸	%coal	%oil	%gas	%fossil total
Korea (North)	83.9%	0.0%	0.0%	83.9%
South Africa	75.4%	-7.9%	1.6%	69.1%
Bosnia and Herzegovina	61.0%	0.0%	0.0%	61.0%
China	54.6%	11.8%	2.7%	69.1%
Former Yugoslav Republic of Macedonia	51.7%	-9.4%	0.0%	42.3%
Kazakhstan	51.7%	14.3%	12.6%	78.6%
Estonia	50.4%	-4.7%	0.0%	45.8%

Contribution of oil production to fuel mix:

When the contribution of oil to the domestic energy consumption is taken into account the picture looks completely different. Table 10 shows a listing of countries with highest contribution of oil to their domestic energy consumption. Dependencies on oil as high as 98% and 86% are observed for Yemen and Iraq, respectively. There are 18 non-OECD countries with a dependency on oil of more than 25%.

For Russia, the share of oil in the domestic fuel mix is 21%.

Striking is the relatively high contribution of natural gas to the domestic fuel mix of countries like Algeria (69%) and Brunei (70%), which is by far higher than the contribution of oil to the fuel mix. This is because a relatively higher part of the domestically produced oil is exported compared to domestically produced natural gas.

Table 10: Non-OECD countries with a contribution of oil of more than 50% to the overall domestic energy production (ktoe/ktoe)⁹

country	%coal	%oil	%gas	%fossil total
Yemen	0.0%	97.8%	0.0%	97.8%
Iraq	0.0%	86.1%	13.2%	99.3%
Libya	0.0%	71.3%	27.6%	98.9%
Ecuador	0.0%	70.5%	3.3%	73.7%
Saudi Arabia	0.0%	57.6%	42.4%	100.0%
Syria	0.0%	55.3%	31.8%	87.2%
Venezuela	0.0%	53.7%	44.4%	98.1%

⁷ Source: IEA, production data 2001

⁸ India has an oil contribution of 30.6% (and therefore not included in this table), but it should be noted that it has a large share of biomass and waste equating to about 40% of total energy consumption

⁹ Source: IEA, production data 2001

3. Approaches to Future Commitments

A variety of approaches have been proposed for future international climate policy post 2012. Summaries are provided in Baumert et al. (2002), Storey (2002), Philibert et al. (2003), Höhne et al. (2003, 2005), Bodansky (2003), Torvanger et al. (2004), and Philibert (2005).

This section provides a systematic overview, mainly in the form of fact sheets, and brief assessment of several approaches and issues that have been proposed. We present them in three groups:

- a) *Differentiation approaches:* These approaches provide methods to differentiate between countries in e.g. the time and form of participation or the stringency of their efforts. These include:
 - 1. Staged approach
 - 2. Contraction and Convergence
 - 3. Common but differentiated convergence
 - 4. Triptych approach
 - 5. Multi-Sector Convergence
 - 6. Responsibility for global warming (Brazilian Proposal)
 - 7. Commitment to human development goals with low emissions
- b) *Types of action:* These approaches discuss only one form or type of action that a country could take on. These include:
 - 8. Absolute emission targets
 - 9. Dynamic targets
 - 10. Non binding targets
 - 11. "No lose" targets
 - 12. Sector targets (absolute or dynamic)
 - 13. Extended CDM
 - 14. Dual targets
 - 15. Price caps
- c) *Other approaches:* This section summarizes other approaches and ideas that are not covered above. They include:
 - i. Approaches for setting national targets
 - ii. Approaches for cross-national activities
 - iii. Procedural approaches
 - iv. Extensions of the agreements

All cases are presented in the same "fact sheet" form. The approach is described and its implications for countries are discussed. We then discuss their strengths and weaknesses. We further make an assessment of the perceived countries positions. We finally provide an overall assessment of the approach and a list of references.

As only a few countries have officially voiced their position, the assessment is our own evaluation and does not represent official positions of a country or country group unless indicated otherwise. We summarise the assessment using the following indicators:

- +**: country or country group might be willing to support the approach
- 0**: unclear whether the country or country group would support the approach
- : country or country group is unlikely to support the approach

I. Differentiation Approaches

Fact sheet 1: Staged approach

Name	Staged approach		
Description	- Increasing participation of countries in different stages with stage-specific targets. - E.g. four stages of commitments: no commitments, de-carbonization targets (decreasing emissions per GDP), stabilisation targets, reduction targets - Countries graduate into next stages when they exceed certain thresholds (e.g. emissions per capita or GDP per capita) - A global emission ceiling is defined. Countries in phase 1-3 follow their respective commitments. The remaining emission allowances are shared between the countries of phase 4 (reduction targets) according to a differentiation key, e.g. historic emissions or per capita emissions - All countries agree to have commitments at a later stage		
Implications	- In order to reach stringent long-term goals (such as maximum increase of 2°C), additional countries, especially newly industrialised countries, need to participate relatively early, best soon after 2012, major regions (East Asia and South Asia) before the middle of the century. Such start would be at significantly lower per capita emissions and GDP levels than Annex I countries. - Model outcomes also critically depend on the time when large countries such as China and India enter the system.		
Discussion	Strengths	Weaknesses	
	- Gradual phase in of countries, in line with UNFCCC spirit, taking into account national circumstances - General framework that can accommodate many ideas and satisfy many demands - Allows for gradual decision making - Trust-building as industrialised countries take the lead - Compatible with Kyoto Protocol (reporting and mechanisms)	- Relative complex concept, requires many decisions and allows for exceptions - Risk that countries enter too late so that some long-term stabilisation options are lost - Incentives needed for countries to participate in a certain stage	
Possible positions	Least developed countries	+	Would not receive targets, but could benefit through CDM
	India	+	Is likely to participate relatively late with quantitative commitments in a multistage setting.
	China	+	In general, China would accept commitments only <i>after</i> the developed countries have demonstrated to take the lead in combating climate change, so the multistage approach with high reduction targets for developed countries and gradual participation of developing countries could be regarded as favourable. Chinas participation would however be required at least by the middle of the century.
	Advanced developing countries	-	These countries would graduate very quickly into stages 2 or 3.
	Group of 77	0	A multistage approach would imply differentiation between developing countries and therefore dividing the G77 into different groups. This may not be in the interest of G77.
	Russia	0	Unknown.
	USA	-	Not in favour of emission limitation targets. Not in favour of developed countries taking the lead.

	Japan	0	Currently not in favour of emission limitation targets.
	Other umbrella group countries ¹⁰	0	Unknown. Norway and Switzerland might be supporters, Australia might face a similar situation like the USA.
	EU	+	In favour of a staged approach.
Overall assessment	- Any future regime is likely to be a staged setting of some form. Countries are very diverse; hence several types of targets are likely to exist in parallel. A staged setting is the most likely outcome of the sequential decision-making that is currently applied. - The critical element of the approach is that additional countries participate early enough so that stringent environmental goals can be reached. Incentives for such participation (not just thresholds) have to be built into the system.		
Variants of the approach	- The staged approach provides a general framework and provides room for many variants in altering stages, targets and thresholds. - Gupta (2003) proposed a concrete grouping of developing countries using GDP/cap and emissions/cap - Ott et al. (2004) propose a concrete grouping of developing countries based on several indicators. - Criqui et al. (2003) analysed a three staged system (no commitment, carbon intensity and reduction) - Höhne et al. (2003, 2005) proposed a multistage setting where the first stage is a pledge for sustainable development (a "soft" target), followed by moderate absolute limits and then absolute reductions. In such a setting, only a few countries change stages in future years: The first stage aims at development with low emissions and therefore the thresholds are not reached.		
References	<i>Exclusively on the approach</i> J. Gupta, 1998 "Encouraging developing country participation in the climate change regime," Institute for Environmental Studies (IVM), Vrije Universiteit, Amsterdam, The Netherlands J. Gupta, 2003, "Engaging developing countries in climate change: (KISS and Make-up!)" in David Michel (ed.), (2003): "Climate Policy for the 21st Century, Meeting the Long-Term Challenge of Global Warming". Washington D.C., Center for Transatlantic Relations http://transatlantic.sais-jhu.edu - Ott, H. E., Winkler, H., Brouns, B., Kartha, S., Mace, M., Huq, S., Kameyama, Y., Sari, A. P., Pan, J., Sokona, Y., Bhandari, P. M., Kassenberg, A., La Rovere, E. L., Rahman, A., 2004: "South-North dialogue on equity in the greenhouse. A proposal for an adequate and equitable global climate agreement" GTZ, Eschborn, Germany <i>Comparing the approach to other approaches</i> - International Energy Agency 2002, "Beyond Kyoto -- Energy Dynamics and Climate Stabilisation", ISBN 92-64-19838-5 P. Criqui, A. Kitous, M. Berk, M. den Elzen, B. Eickhout, P. Lucas, D. van Vuuren, N. Kouvaritakis and D. Vanregemorter, 2003, "Greenhouse Gas Reduction Pathways In The UNFCCC Process Up To 2025 – Technical Report", Study Contract: B4-3040/2001/325703/MAR/E.1 for the European Commission, DG Environment http://europa.eu.int/comm/environment/climat/pdf/pm_techreport2025.pdf - Den Elzen, M.G.J., Berk, M.M., Lucas, P., Eickhout, B. and Van Vuuren, D.P., 2003. Exploring climate regimes for differentiation of commitments to achieve the EU climate target. RIVM Report no. 728001023, National Institute of Public Health and the Environment, Bilthoven, the Netherlands http://arch.rivm.nl/iweb/iweb/Reports/728%20001%20023_final_V1.pdf - Höhne, N., J. Harnisch, G.J.M. Phylipsen, K. Blok, C. Galleguillos (2003): Evolution of commitments under the UNFCCC: Involving newly industrialized economies and developing countries. Research Report 201 41 255. UBA-FB 000412 http://www.umweltbundesamt.org/fpdf-l/2246.pdf - Höhne, N., D. Phylipsen, S. Ullrich, K. Blok, 2005: "Options for the second commitment period of the Kyoto Protocol", Climate Change 02/05, ISSN 1611-8855, prepared by Ecofys for the German Federal Environmental Agency, Berlin, Germany, available at http://www.umweltbundesamt.org/fpdf-l/2847.pdf		

¹⁰ E.g. Australia, New Zealand, Norway, and Switzerland.

Fact Sheet 2: Contraction and Convergence (C&C)

Name		Contraction and Convergence (C&C)	
Description		- All countries participate in this regime with quantified emission targets. - As a first step, all countries agree on a path of future global emissions that leads to an agreed long-term stabilisation level for greenhouse gas concentrations ('Contraction') - As a second step, the targets for individual countries are set so that per-capita emissions converge from the current level of the country to a level equal for all countries within a convergence period ('Convergence'). The convergence is calculated in a way that resulting global emissions follow the agreed global emission path. - Global emission trading would be allowed to level off differences between allowances and actual emissions.	
Implications		- Current per-capita emissions differ greatly between countries. Some developing countries could be allocated more emission allowances than necessary to cover their emissions ("hot air"). This would generate a flow of resources from developed to developing countries. - Relatively strict long-term targets (e.g. 450 ppmvCO₂) and convergence by, e.g., 2050, not all developing countries would benefit from this approach. As the per-capita emissions have to converge to a level below current average of developing countries, those developing countries above or close to the average (e.g. Argentina, Brazil, Venezuela, Mexico, South Africa, South Korea, Namibia, Thailand, China) will soon (e.g. 2020) be constrained and will not receive excess allowances. More excess allowances would be available under a higher concentration target, e.g. 550 ppmvCO₂, or under earlier convergence, e.g. by 2030. - Reaching a fixed global emission level is easier for Annex I countries if all Non-Annex I countries participate immediately (C&C), compared to a gradual phase-in of developing countries receiving commitments (a staged approach), because only then relatively cost-effective mitigation options in some developing countries can be accessed and traded within the system.	
Discussion		Strengths	Weaknesses
		- Participation of all countries - Certainty about global emissions - Simple, clear concept - Includes cost-effective reduction options in developing countries through full international emissions trading - Support for least developed countries through excess emission rights - Compatible with Kyoto Protocol (reporting and mechanisms)	- National circumstances (incl. historical responsibility) not accommodated - Substantial reduction for countries with high per capita emissions, also such developing countries - Also least developed countries need to be capable to participate in emissions trading (national greenhouse gas inventories and emission trading authorities) - Excess emission rights need to be compensated by developed countries.
Possible positions	Least developed countries	+	Benefit greatly through allocation of excess emission rights.
	India	+	As the host of COP 8 in November 2002, The Prime Minister of India, Mr. Vajpayee, stressed that a call for developing country commitments would be "misplaced" as Indian per-capita emissions are below the world average, the per-capita income and greenhouse gas emissions per unit of GDP are low compared to those of Annex I countries. He stressed that the only equitable form for the future would be one based on equal per-capita rights (without further specifying whether this means C&C).
	China	-	China's per-capita emissions are around the Non-Annex I average and growth in emissions would be capped in the early part of the century.
	Advanced developing countries	-	Per-capita emissions are above Non-Annex I average. These countries would opt for more consideration of historical responsibility.

Group of 77	+	G77 introduced a first mention of "narrowing per-capita differences between developed and developing country Parties" in preambular part of the decision on the Kyoto mechanisms (Decision 17/CP.7).
Russia	0	Unknown. But relatively high per capita emissions.
USA	-	The approach would imply major reductions as USA per-capita emissions are among the highest globally. USA objects already the concept of using per-capita emissions as an indicator.
Japan	0	Unknown.
Other umbrella group countries	0	Unknown.
EU	0	Unlikely to receive support as a staged approach was favoured in the past.
Overall assessment	- The concept of eventually converging per-capita emissions in the long term could be part of a future regime - But classic Contraction and Convergence is too simple to accommodate the concerns of all countries - A decision that all countries participate at once may be unrealistic.	
Variants of the approach	<i>Allocation of equal per-capita rights:</i> With the start of the system, all countries receive emission rights proportional to their population. Differences between allowances and actual emissions would be extreme. The C&C approach with a convergence period was developed to overcome this shortcoming. <i>Per capita plus:</i> Addition of further rules to accommodate special national circumstances, e.g., by allowing for delayed entry into the scheme, differing types of targets in the beginning. This approach would be a further elaboration of the C&C approach. The NGO community intended to further develop this approach, but has stopped their efforts.	
References	<i>Exclusively on the approach</i> - Global Commons Institute: http://www.gci.org.uk/images/CC_Demo(pc).exe - Agarwal, A. 1999, Making the Kyoto Protocol work, Centre for Science and environment, New Delhi, India, available at http://www.cseindia.org/html/cmp/cmp33.htm - M.A. Aslam 2002 "Equal per capita Entitlements: A key to global participation on Climate Change?" in K. Baumert (ed.), "Building on the Kyoto Protocol, Options for protecting the climate", World resources Institute, Washington, USA, http://pubs.wri.org/pubs_pdf.cfm?PubID=3762 <i>Comparing the approach to other approaches</i> - International Energy Agency 2002, "Beyond Kyoto -- Energy Dynamics and Climate Stabilisation", ISBN 92-64-19838-5 P. Criqui, A. Kitous, M. Berk, M. den Elzen, B. Eickhout, P. Lucas, D. van Vuuren, N. Kouvaritakis and D. Vanregemorter, 2003, "Greenhouse Gas Reduction Pathways In The UNFCCC Process Up To 2025 – Technical Report", Study Contract: B4-3040/2001/325703/MAR/E.1 for the European Commission, DG Environment http://europa.eu.int/comm/environment/climat/pdf/pm_techreport2025.pdf - Den Elzen, M.G.J., Berk, M.M., Lucas, P., Eickhout, B. and Van Vuuren, D.P., 2003. Exploring climate regimes for differentiation of commitments to achieve the EU climate target. RIVM Report no. 728001023, National Institute of Public Health and the Environment, Bilthoven, the Netherlands, page 53, http://arch.rivm.nl/iweb/iweb/Reports/728%20001%20023_final_V1.pdf - Höhne, N., J. Harnisch, G.J.M. Phylipsen, K. Blok, C. Galleguillos (2003): Evolution of commitments under the UNFCCC: Involving newly industrialized economies and developing countries. Research Report 201 41 255. UBA-FB 000412, page 41, http://www.umweltbundesamt.org/fpdf-l/2246.pdf - Höhne, N., D. Phylipsen, S. Ullrich, K. Blok, 2005: "Options for the second commitment period of the Kyoto Proto-col", Climate Change 02/05, ISSN 1611-8855, prepared by Ecofys for the German Federal Environmental Agency, Berlin, Germany, available at http://www.umweltbundesamt.org/fpdf-l/2847.pdf - WBGU, 2003 "Climate Protection Strategies for the 21st Century. Kyoto and Beyond", http://www.wbgu.de/wbgu_sn2003_engl.html	

Fact sheet 3: Common but Differentiated Convergence (CDC)

Name		Common but Differentiated Convergence (CDC)	
Description		- Annex I countries' per capita emission allowances converge within, e.g. 40 years (2010 to 2050), to an equal level for all countries. Individual Non-Annex I countries' per capita emissions also converge within 40 years to the same level but convergence starts from the date, when their per capita emissions reach a certain percentage threshold of the (gradually declining) global average. - Non-Annex I countries that do not pass this percentage threshold do not have binding emission reduction requirements. Either they take part in the Clean Development Mechanism or they voluntarily take on "positively binding" emission reduction targets. Under the latter, emission allowances may be sold if the target is overachieved, but no emission allowances have to be bought if the target is not reached.	
Implications		The CDC approach, similarly to C&C, aims at equal per capita allowances in the long run. In contrast to C&C it considers the historical responsibility. Annex I countries would have to reduce emissions similarly to C&C, but many Non-Annex I countries are likely to have more time to develop until they need to reduce emissions. Non-Annex I country participation is conditional to Annex I action through the gradually declining world average threshold. No "hot air" would occur.	
Discussion		Strengths	Weaknesses
		- Applies simple rules thus making approach transparent and comprehensive - Delay of Non-Annex I countries takes account of the responsibility for past emissions - Certainty about global emissions - Eliminates the component of "hot air" (no excess allowances for low emission countries) - Compatible with Kyoto Protocol (reporting and mechanisms)	Possibly too simple and not considering detailed national circumstances
Perceived Positions		Least developed countries	0 Are exempt, but also not supported through "hot air" as under C&C.
		India	+ Would welcome a delayed start of reduction efforts.
		China	+ Would welcome a delayed start of reduction efforts. Made remarks on delayed reductions in public.
		Advanced developing countries	+ Might support proposal, more than C&C.
		Group of 77	0 Could support the concept.
		Russia	0 Unknown position.
		USA	- The approach would imply major reductions as USA per-capita emissions are among the highest globally. USA objects already the concept of using per-capita emissions as an indicator
		Japan	0 Unknown position.
		Other umbrella group countries	0 Unknown position.
		EU	+ Could receive support, as it is a staged system, but possibly too simple to take into account all national circumstances.
Overall assessment		Even if the "Common but Differentiated Convergence" approach is not implemented in its entirety, future decisions can be guided by the principles provided in the approach: that developed countries' per capita emissions converge and that developing countries do the same but delayed and conditional to developed country action.	
Variants of the approach		None. A similar approach is Contraction and Convergence (see Fact sheet 2)	

References*Exclusively on the approach*

- Höhne, Niklas; Michel den Elzen, Martin Weiss, 2004: "Common but differentiated convergence", in Niklas Höhne, Dian Phylipsen, Simone Ullrich, Kornelis Blok, 2004: „Options for the second commitment period for the Kyoto Protocol", Research report for the German Federal Environmental Agency

Comparing the approach to other approaches

- Höhne, N., D. Phylipsen, S. Ullrich, K. Blok, 2005: "Options for the second commitment period of the Kyoto Protocol", Climate Change 02/05, ISSN 1611-8855, prepared by Ecofys for the German Federal Environmental Agency, Berlin, Germany, available at <http://www.umweltbundesamt.org/fpdf-l/2847.pdf>
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Fact sheet 4: Triptych approach

Name		Triptych approach	
Description		- The Triptych approach describes a way to allocate national targets based on sectoral considerations. - The approach originally covered three sectors (the heavy industry sector, the power sector and the domestic sectors) and was later extended to include also process emissions from industry, agriculture, waste and land-use change and forestry. - The emissions of the sectors are treated differently: For 'electricity production and industrial production', a growth in the physical production is assumed together with an improvement in production efficiency. This takes into account the need for economic development but constant improvement of efficiency. For the 'domestic' sectors, convergence of per-capita emissions is assumed. This takes into account the converging living standard of the countries. For the remaining sectors similar rules are applied. - The allowances of the sectors are added up to one fixed national allowance for each country. Only this national target per country is proposed, no sectoral targets, to allow countries the flexibility to pursue any cost-effective emission reduction strategy.	
Implications		- Substantial reductions for the industrialised countries, esp. those with carbon intensive industries (Eastern Europe and Russian Federation). - Substantial emission increases are allowed for most developing countries; for lower concentration targets (e.g. 450 ppmv CO₂) rarely above BAU-emissions.	
Discussion		Strengths	Weaknesses
		- National circumstances are explicitly accommodated - Explicitly allowing for economic growth at improving efficiency in all countries - Aims to put internationally-competitive industries on same level - Has been successfully been applied (on EU level) as a basis for negotiating targets - Compatible with Kyoto Protocol (reporting and mechanisms)	- High complexity of the approach requires many decisions and sectoral data, making global application a challenge, and may be perceived as not transparent - Agreement on required projections of production growth rates for heavy industry and electricity may be difficult
Possible positions		Least developed countries	+ Substantial emission increases would be allowed for sustainable economic growth.
		India	+ India is one of the countries with the highest allowed increase in emissions and thus could support the approach.
		China	0 No position known. Emissions would be capped below reference relatively early.
		Advanced developing countries	- No position known, but will need to reduce emissions below reference in the early half of the century.
		Group of 77	0 This approach would allow one type of target for all (or most) countries in the G77, a split of the group is not necessary.
		Russia	0 Unknown position.
		USA	- Substantial reductions, as current emission levels of heavy industry, the power sector and domestic per capita emission are high.
		Japan	+ Approach could receive support, as Japan is already now very efficient.
		Other umbrella group countries	0 Unknown position. Similarly to the USA, substantial reductions will be required for the group.
		EU	+ Has been applied within the EU. Could receive support as method to share emission allowances for a group of countries.

Overall assessment	- The most sophisticated approach to share emission allowances within any group of countries. Could be applied globally but best on any subset of countries (e.g. in the group of reducing countries in a staged approach) provided sectoral data are available. - Approach accommodates concerns of many countries
Variants of the approach	- The Triptych approach has been developed in 1997 and was extended since then (Blok, Phylipsen, Groenenberg, Höhne, den Elzen). Additional sectors were included and new methodologies applied. - Wagner and Michaelowa (forthcoming) applied a similar approach for nine sectors for the EU for the second commitment period.
References	<i>Exclusively on the approach</i> - Blok, K. G.J.M. Phylipsen and J.W. Bode, 1997, The Triptych Approach; Burden sharing differentiation of CO₂ emissions reduction among EU member states, discussion paper for the informal workshop for the European Union Ad Hoc Group on Climate, Zeist, the Netherlands, January 16-17, 1997, Dept. of Science, Technology and Society, Utrecht University, Utrecht, 1997 (9740) - Phylipsen, G.J.M., H. Groenenberg, K. Blok, 1998, The EU Burden Sharing After Kyoto – Renewed Triptych Calculations, Dept. of Science, Technology and Society, Utrecht University, Utrecht - Groenenberg, H., D. Phylipsen, K. Blok, 2001, 'Differentiating commitments world wide: global differentiation of GHG emissions reductions based on the Triptych approach-a preliminary assessment', Energy Policy, vol.29, issue12, pp 1007-1030, 2001 - Groenenberg 2002, "Development and Convergence – A bottom up analysis for the differentiation of future commitments under the Climate Convention", PhD thesis, University of Utrecht, ISBN 90-393-3189-8 F. Wagner and A. Michaelowa, "Burden sharing targets for the EU Bubble in the second commitment period: CO₂ from the energy sector" (forthcoming) - Höhne, N., D. Phylipsen, S. Ullrich, K. Blok, 2005: "Options for the second commitment period of the Kyoto Protocol", Climate Change 02/05, ISSN 1611-8855, prepared by Ecofys for the German Federal Environmental Agency, Berlin, Germany, available at http://www.umweltbundesamt.org/fpdf-l/2847.pdf <i>Comparing the approach to other approaches</i> - Höhne, N., J. Harnisch, G.J.M Phylipsen, K. Blok, C. Galleguillos (2003): Evolution of commitments under the UNFCCC: Involving newly industrialized economies and developing countries. Research Report 201 41 255. UBA-FB 000412, page 41, http://www.umweltbundesamt.org/fpdf-l/2246.pdf - Höhne, N., D. Phylipsen, S. Ullrich, K. Blok, 2005: "Options for the second commitment period of the Kyoto Proto-col", Climate Change 02/05, ISSN 1611-8855, prepared by Ecofys for the German Federal Environmental Agency, Berlin, Germany, available at http://www.umweltbundesamt.org/fpdf-l/2847.pdf - Den Elzen, M.G.J., Berk, M.M., 2004. Bottom up approaches for defining future climate mitigation commitments. RIVM report no. 728001029, National Institute for Public Health and the Environment, Bilthoven, the Netherlands, available at http://arch.rivm.nl/ieweb/ieweb/reports/728001029.pdf

Fact Sheet 5: Multi-Sector Convergence

Name	Multi-Sector Convergence		
Description	• Per-capita emissions of sectors converge to equal levels. These global standards are based on reduction opportunities in these sectors. • Seven sectors are covered: power, industry, transport, households, services, agriculture and waste. • The single sectoral targets are added to form an absolute national target. Only the national target is binding, not the sectoral ones. • Countries participate only when exceeding thresholds: when having very low per capita emission levels, no emission constraints are set in order to allow for economic development. Countries with low per capita emissions exceeding a graduation threshold are granted a pre-set adjustment period. After this period countries are given targets as described above. • Country specific elements, e.g. specific emission factors or the population density can be included in the approach.		
Implications	• The multi-sector convergence approach takes into consideration the different emissions structures of the countries. It can take into account that emissions from some sectors, e.g. transport, are difficult to reduce (resulting in a high sector per-capita convergence level), while emissions in other sectors, e.g. from landfills, are relatively easy to reduce (resulting in low sector per-capita convergence levels). Under the multi-sector convergence approach, a country with high landfill emissions has to reduce emissions more than a country with high transport emissions. • No excess emissions are provided to least developed countries (as is the case for contraction and convergence).		
Discussion	Strengths	Weaknesses	
	• Simple, clear basic concept • Sectoral split allows for accommodation of current differences in emissions structure • Phase-in into involvement through adjustment period before taking up targets • Compatible with Kyoto Protocol (reporting and mechanisms)	• Sectoral emissions, especially from industry, are not always related to population • Concept becomes very complex in particular when allowing adjustment periods and exceptions • Is data demanding and is difficult to negotiate	
Perceived Positions	Least developed countries	+	Would not receive targets, but could benefit through CDM
	India	+	As the host of COP 8 in November 2002, The Prime Minister of India, Mr. Vajpayee, stressed that the only equitable form for the future would be one based on equal per-capita rights. He did not specify whether multi-sector convergence falls within this category.
	China	-	No position known, but China's per-capita emissions are around the Non-Annex I average and growth in emissions would be capped in the early part of the century
	Advanced developing countries	-	No position known, but per-capita emissions are above Non-Annex I average. These countries would opt for more consideration of historical responsibility
	Group of 77	0	No position known. G77 introduced a first mention of "narrowing per-capita differences between developed and developing country Parties" in preambular part of the decision on the Kyoto mechanisms (17/CP.7).
	Russia	0	Unknown position
	USA	-	The approach implies major reductions as USA per-capita emissions are among the highest of Annex I. USA objects already the concept of using per-capita emissions as an indicator.

	Japan	0	Unknown position
	Other umbrella group countries	0	Unknown position
	EU	0	Unknown position
Overall assessment	- The approach is a mix of contraction and convergence, multistage and Triptych. - Splitting into sectoral analysis has the disadvantage that it increases complexity, but has the advantage that national circumstances might be better taken into account. In the Multi-Sector Convergence approach, the sectoral differences are not as well covered as in the Triptych approach, since different industrial and agricultural activities may not be directly related to population. If sectoral detail is considered, then the Triptych approach would be preferred over Multi-Sector Convergence.		
Variants of the approach	No further research has been published since the original proposal 2001		
References	<i>Exclusively on the approach</i> - Jansen, J.C., J.J. Battjes, J.P.M. Sijm, C.H. Volkers, J.R.Ybema, 2001, The Multi-sector convergence approach, Center for International Climate and Environmental Research Norway (CICERO) and the Energy Research Center of the Netherlands (ECN), CICERO WP 2001:4 - Sijm, Jos, Jaap Jansen, and Asbjørn Torvanger (2001), Differentiation of mitigation commitments: the multi-sector convergence approach, Climate Policy, Vol. 1, No. 4, 481-497 <i>Comparing the approach to other approaches</i> - Höhne, N., J. Harnisch, G.J.M. Philipsen, K. Blok, C. Galleguillos (2003): Evolution of commitments under the UNFCCC: Involving newly industrialized economies and developing countries. Research Report 201 41 255. UBA-FB 000412, page 41, http://www.umweltbundesamt.org/fpdf-l/2246.pdf		

Fact Sheet 6: Responsibility for Global Warming (Brazilian Proposal)

Name	Responsibility for Global Warming (Brazilian Proposal)		
Description	- Originally proposed by Brazil as a method to differentiate emission reduction targets between Annex I countries for the Kyoto Protocol (UNFCCC 1997). - The proposal suggested that reductions towards an overall emission ceiling for all Annex I Parties (30 per cent below 1990 levels by the year 2020) were to be shared among individual Annex I Parties proportional to their relative share of responsibility for climate change. - The original paper presented by Brazil in 1997 proposed an approach for estimating the relative share of responsibility for climate change of different Annex I Parties, based on their contribution to the increase of global-average surface temperature over a certain period of time. - The proposal suggested using an agreed simple climate model for estimating the temperature increase resulting from emissions of different countries.		
Implications	- The approach requires a complex analysis to attribute country's contributions to temperature change based on historic emissions, which is subject to further research (see references below to the MATCH project). - In general, countries with a longer process of industrialisation and thus a longer record of greenhouse gas emissions will have a greater share of responsibility for emission reductions than countries, which industrialised later. If emissions from land-use change and forestry are taken into account, also some developing countries will have relatively high contributions. - Original method can only be applied to absolute emission <i>reductions</i>. If applied on a global scale decisions are needed on which countries participate (e.g. a GDP threshold by den Elzen et al. 2003), and, if needed, how targets for newly participating countries could allow controlled <i>increase</i> in emissions (e.g. reductions below a reference scenario as in Blanchard 2002).		
Discussion	Strengths - Only proposal made officially by a developing country and that is still officially discussed under the UNFCCC - Compatible with Kyoto Protocol (reporting and mechanisms)	Weaknesses - Original method can only be applied to absolute emission <i>reductions</i> - Contributions to temperature increase may be complex to calculate - Very high reductions for countries with long emission history	
Perceived Positions	Least developed countries	+	Very likely to be exempt.
	India	0	No position known, but insistently worked towards postponement of the UNFCCC discussion on the approach (probably not because of the approach, but to block any discussion on the future).
	China	0	No position known, but insistently worked towards postponement of the UNFCCC discussion on the approach (probably not because of the approach, but because to block any discussion on the future).
	Advanced developing countries	+	No position known, but could benefit due to low historical responsibility, while high per capita emissions.
	Group of 77	+	Supportive of the concept. But some developing countries would not be in favour of the approach due to high emissions from deforestation.
	Russia	0	Unknown position.
	USA	0	No position known, but historical responsibility of the USA can be smaller than that of the EU.
	Japan	0	Unknown position.
	Other umbrella group countries	0	Unknown position.

EU	0	Supporting the official discussion on it, also to support any discussion on the future. EU countries have relatively high historical responsibility.
Overall assessment	- The approach has been brought forward by a developing country. It is therefore attractive to pursue it further. - It, however, needs to be further developed for the global scale to ensure that strict environmental goals (e.g. 2°C) can be reached. If Non-Annex I countries are not participating until their contribution to climate change is equal to that of Annex I countries, stringent goals cannot be reached. - Application of the approach on the global level is unclear.	
Variants of the approach	- Introducing GDP participation threshold (den Elzen et al. 2003) - Introducing reductions below a reference scenario for all countries (Blanchard 2002)	
References	<i>Exclusively on the approach</i> - UNFCCC 1997, 'Implementation of the Berlin Mandate, Additional proposal by Parties'. Document FCCC/AGBM/1997/MISC.1/Add.3, http://unfccc.int/resource/docs/1997/agbm/misc01a3.pdf - Meira Filho, L.G. and Gonzales Miguez, J.D. 2000, 'Note on the time-dependant relationship between emissions of greenhouse gases and climate change', Technical note, Ministry of science and technology Federal Republic of Brazil, http://unfccc.int/program/mis/brazil/documents/proposta.pdf - Den Elzen, M.G.J., Schaeffer, M, and Eickhout, B., 2002: 'Responsibility for past and future global warming: time horizon and non-linearities in the climate system', RIVM Report 728001022, Dutch National Institute for Public Health and the Environment, Bilthoven, the Netherlands. http://www.rivm.nl/bibliotheek/rapporten/728001022.pdf - Emilio L. La Rovere, Laura Valente de Macedo, and Kevin A. Baumert 2002, "The Brazilian Proposal on Relative Responsibility for Global Warming" in K. Baumert (ed.), "Building on the Kyoto Protocol, Options for protecting the climate", World resources Institute, Washington, USA, http://pubs.wri.org/pubs_pdf.cfm?PubID=3762 N. Höhne, K. Blok, "Calculating historical contributions to climate change – discussing the 'Brazilian Proposal'" Climatic Change, (forthcoming) - Ad-hoc group for the modelling and assessment of contributions to climate change (MATCH) see http://www.match-info.net/ <i>Comparing the approach to other approaches</i> - Den Elzen, M.G.J., Berk, M.M., Lucas, P., Eickhout, B. and Van Vuuren, D.P., 2003. Exploring climate regimes for differentiation of commitments to achieve the EU climate target. RIVM Report no. 728001023, National Institute of Public Health and the Environment, Bilthoven, the Netherlands http://arch.rivm.nl/ieweb/ieweb/Reports/728%20001%20023_final_V1.pdf O. Blanchard 2002, "Scenarios for differentiating commitments" in K. Baumert (ed.), "Building on the Kyoto Protocol, Options for protecting the climate", World resources Institute, Washington, USA, http://pubs.wri.org/pubs_pdf.cfm?PubID=3762	

Fact Sheet 7: Commitment to human development goals with low emissions

Name		Commitment to human development goals with low emissions	
Description		- The "commitment to human development with low emissions" approach draws a line between basic and luxury (wasteful) goods and associated emissions. - It proposes commitments in three parts: - Voluntary (non-binding) commitment: All countries commit to emission levels that take into account the autonomous energy efficiency improvements that will happen in the future. For developed countries, this part can be made obligatory. - Conditional commitment: Developing countries will make additional efforts to reduce emissions. Developed countries (partly) finance these efforts and will receive credits. Conditions: - Transfer of technologies or financial assistance by developed countries; - Emissions reductions will not compromise development goals nor encourage luxurious emissions; and - No credits will be accounted, if progress towards development goals is not made. - Obligatory commitments: In developed and developing countries, emissions for basic needs must be granted. On the other, hand wasteful emissions must be discouraged (but not forbidden). A progressive tax is proposed to discourage wasteful emissions in all countries. - Three steps operationalize this approach: (1) Assessment of development goals, (2) design of commitment, and (3) Review of the goals and commitments ex ante and ex post to avoid "hot air".	
Implications		- Only those countries, whose greenhouse gas emissions go beyond those needed for the basic needs would need to act. - The approach has not yet been quantified, but it is likely that major reductions are necessary in developed countries.	
Discussion		Strengths	Weaknesses
		- Participation of all countries with similar commitments - Focuses on development goals first and derived emission reduction options - Takes into account intra-national differences, by discouraging wasteful emissions in all countries - Avoids creation of "hot air" through review - Compatible with Kyoto Protocol (reporting and mechanisms)	- Unresolved how basic and wasteful emissions should be quantified. Proposed are simple indicators using the world average - Requires a governmental development planning process - Requires detailed review of development goals and targets, as these are developed "bottom-up" - Potential to discriminate against specific nations, cultures and habits - Proposal needs further elaboration
Perceived Positions		Least developed countries	+ No position known, but likely welcome approach since LDCs are supported to pursue human development goals.
		India	+ No position known, but likely welcome approach since supported to pursue human development goals.
		China	+ China has mentioned the approach to differentiate basic and wasteful emissions at the UNFCCC negotiations.
		Advanced developing countries	+ No position known, but the notion that action is conditional to transfers was also raised by e.g. Korea.
		Group of 77	+ No position known. Group could in general support approach
		Russia	0 Unknown position.
		USA	- No position known yet. Approach could result in harming producers of goods classed as luxurious. Payments for developing country action may induce opposition.

Japan	-	Unknown position. Approach could result in harming producers of goods classed as luxurious. Payments for developing country action may induce opposition.
Other umbrella group countries	-	Unknown position. Approach could result in harming producers of goods classed as luxurious. Payments for developing country action may induce opposition.
EU	0	Could be supportive but may have reservations over difficulties making it operational and necessity of value-based judgements.
Overall assessment	• Is one of the rare approaches suggested from a developing country perspective • The approach might become difficult to operationalize because the definition of basic and luxurious goods and emissions is a prerequisite. An international agreement would be difficult and time consuming to achieve since such definition would need to take different cultures and circumstances of nations into account. • Approach is still in its early development stages.	
Variants of the approach	• Developing country action is conditional on transfers from developed countries, which is very similar to the basic idea of the CDM linked voluntary dynamic target and "no lose" targets	
References	• Pan, Jiahua (2003) "Commitment to Human Development Goals with Low Emissions", presentation at HWWA, Germany http://www.hwwa.de/Projekte/Forsch_Schwerpunkte/FS/Klimapolitik/PDFDokumente/pa n.pdf • Pan, Jiahua, 2003: Commitment to Human Development Goals with Low Emissions in: " K.L. Hüttner, J.-Fr. Hake, W. Fischer (eds) " Climate Change Mitigation and Adaptation, Identifying Options for Developing Countries", Proceedings of the Summer School on Climate Change 7-17 September, Münstereifel, Germany	

II. Alternative Target Approaches

In the following, alternative target types are summarised.

Fact Sheet 8: Absolute emission targets

Name	Absolute emission targets		
Description	- Absolute emissions in a target year are capped for all participating countries - Emission trading is allowed		
Implications	Emission trading allows that final marginal abatement costs are made equal in all participating countries		
Discussion	Strengths	Weaknesses	
	- Compatible with Kyoto Protocol (reporting and mechanisms) - Certainty in future emissions - Flexible across gases, sectors and borders (emission trading)	Criticized by some as too rigid; not able to take into account unexpected economic development	
Perceived Positions	Least developed countries	0	Unlikely to be applied to least developed countries
	India	0	Currently strictly against emission targets, so unlikely to be applied to India
	China	0	Currently strictly against emission targets, so unlikely to be applied to China
	Advanced developing countries	0	Voiced objections against absolute caps
	Group of 77	+	Welcome this type of target for developed countries
	Russia	0	Unknown position
	USA	-	Reject it as too rigid
	Japan	0	Agreed to it under the Kyoto Protocol but often call for alternatives in a second commitment period
	Other umbrella group countries	+	Most agree to it
	EU	+	Preferred type of target
Overall assessment	Absolute emission targets have proven viable in the Kyoto system and in the EU emission trading system.		
Variants of the approach	Alternative types of emission targets (see following fact sheets).		
References	<i>Comparing the approach to other approaches</i> - International Energy Agency 2002, "Beyond Kyoto -- Energy Dynamics and Climate Stabilisation", ISBN 92-64-19838-5 - Den Elzen, M.G.J., Berk, M.M., Lucas, P., Eickhout, B. and Van Vuuren, D.P., 2003. Exploring climate regimes for differentiation of commitments to achieve the EU climate target. RIVM Report no. 728001023, National Institute of Public Health and the Environment, Bilthoven, the Netherlands http://arch.rivm.nl/iweb/iweb/Reports/728%20001%20023_final_V1.pdf - Höhne, N., J. Harnisch, G.J.M. Philipsen, K. Blok, C. Galleguillos (2003): Evolution of commitments under the UNFCCC: Involving newly industrialized economies and developing countries. Research Report 201 41 255. UBA-FB 000412 http://www.umweltbundesamt.org/fpdf-l/2246.pdf		

Fact Sheet 9: Dynamic targets

Name		Dynamic targets	
Description		- Emission targets are expressed dynamically as a function of GDP. - Most common is the intensity target (Emissions/GDP).	
Implications		Intensity targets aim at providing more flexibility to the countries, so that extremely high costs are avoided, if the economic development and therefore emission development is different than expected at the time the target is set. In principle they do not limit the economic growth of countries, but requires that economic development takes place in a carbon-efficient way.	
Discussion		Strengths	Weaknesses
		- Focuses on improving the carbon efficiency of economies - Compatible with Kyoto Protocol (reporting and mechanisms), but requires additional rules for emission trading	- Uncertainty of the global emission level, environmental effectiveness not guaranteed - Problematic if GDP is reduced due to economic difficulties - Such targets are difficult to set and to compare between countries - Requires monitoring of the GDP
Perceived Positions	Least developed countries	0	Unlikely to be applied to least developed countries
	India	0	Currently strictly against emission targets, so unlikely to be applied to India
	China	0	Currently strictly against emission targets, so unlikely to be applied to China
	Advanced developing countries	+	Voiced by advanced developing countries as an interesting option
	Group of 77	+	Could be favourable as it is welcomed by advanced developing countries
	Russia	0	Unknown position.
	USA	+	The USA has adopted an intensity target as national target in the place of its Kyoto target. It is however unknown, whether an intensity target of the same stringency as the USA Kyoto target would be accepted by the USA.
	Japan	+	Unknown position. Might depend how stringent the target is set.
	Other umbrella group countries	+	Unknown position. Might depend how stringent the target it set.
	EU	0	Not pushing for this type of target, but possibly could accept it, if set at a sufficiently stringent level
Overall assessment		Intensity targets (expressed as emissions per GDP) could be set as stringent as absolute targets although the ultimate outcome remains uncertain. Their use needs to be considered with care since setting such targets is difficult as it involves additional knowledge about the relation between emissions and GDP.	
Variants of the approach		- Emission targets expressed dynamically as a function of physical production (e.g. emissions per tonne of steel produced). - Infinite number of possible indexation formula between emissions and GDP	

References*Exclusively on the approach*

- A. Denny Ellerman; Wing, S. (2003): Absolute versus intensity-based emission caps Climate Policy, Volume 3, Supplement 2, December 2003, Pages S7-S20
- Höhne, N. and Harnisch J., 2003; Greenhouse gas intensity targets vs. absolute emission targets; Proceedings of the 6th International Conference on Greenhouse Gas Control Technologies (GHGT-6) Kyoto (Japan), October 2002, Eds. J. Gale and Y. Kasa, Pergamon Press, Vol. II, pp. 1145-1150
- J.W. Sun 2000, "Is CO₂ emission intensity comparable?", Energy Policy 28, 1081-1084

Comparing the approach to other approaches

- International Energy Agency 2002, "Beyond Kyoto -- Energy Dynamics and Climate Stabilisation", ISBN 92-64-19838-5
- Den Elzen, M.G.J., Berk, M.M., Lucas, P., Eickhout, B. and Van Vuuren, D.P., 2003. Exploring climate regimes for differentiation of commitments to achieve the EU climate target. RIVM Report no. 728001023, National Institute of Public Health and the Environment, Bilthoven, the Netherlands
http://arch.rivm.nl/ieweb/ieweb/Reports/728%20001%20023_final_V1.pdf
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<http://www.umweltbundesamt.org/fpdf-l/2246.pdf>

Fact Sheet 10: Non-binding targets

Name		Non-binding targets	
Description		- An emission target would be set, but not reaching the target has no consequences. - These targets could be applied by a subgroup of, e.g., newly participating countries.	
Implications		- Non-binding targets aim at providing more flexibility to the countries, that would not take on a target otherwise - However, providing this flexibility reduces the certainty that a given emission level is reached. - Emission trading is not possible.	
Discussion		Strengths	Weaknesses
		May enable a country to take on a target that would have no target otherwise	- No guarantee that the emission targets are reached - Reduce certainty on the global emission level, environmental effectiveness not guaranteed - Emission trading not possible
Perceived Positions	Least developed countries	0	Unlikely to have move many countries to taking on such a commitment as emission trading is not possible
	India	0	Unlikely to have move many countries to taking on such a commitment as emission trading is not possible
	China	0	Unlikely to have move many countries to taking on such a commitment as emission trading is not possible
	Advanced developing countries	-	Unlikely to have move many countries to taking on such a commitment as emission trading is not possible
	Group of 77	-	Unlikely to have move many countries to taking on such a commitment as emission trading is not possible
	Russia	0	Unknown position
	USA	-	Could be seen as too little commitment towards an agreement on longer-term efforts from developing countries.
	Japan	-	Could be seen as too little commitment towards an agreement on longer-term efforts from developing countries.
	Other umbrella group countries	-	Could be seen as too little commitment towards an agreement on longer-term efforts from developing countries.
	EU	-	Unlikely to accept such targets for a wide range of countries as they do not ensure environmental effectiveness
Overall assessment		- Some developing countries could take non-binding targets as a first step in a future climate regime. "No lose" targets should be considered as alternative.	
Variants of the approach		Non-binding targets are discussed to be an application of the price cap principle for developing countries	

References*Comparing the approach to other approaches*

- Baumert, K.A.; O. Blanchard; S. Llosa ; J.F. Perkaus (2002) „Building on the Kyoto Protocol, options for protecting the climate”
- International Energy Agency 2002, “Beyond Kyoto -- Energy Dynamics and Climate Stabilisation”, ISBN 92-64-19838-5
- Philibert, C.; J. Pershing, J. C. Morlot and S. Willems (2003) Evolution of Mitigation Commitments: Some Key Issues. OECD and IEA Information Paper
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<http://www.umweltbundesamt.org/fpdf-l/2246.pdf>

Fact Sheet 11: "No lose" targets

Name	"No lose", "one way" or "positively binding" targets		
Description	Emission rights can be sold if the target is achieved and even exceeded, but no additional emission rights have to be bought (and no rights have been sold), if the target is not met.		
Implications	- The option aims at providing more flexibility to newly entering the countries, so that high costs are avoided, if the economic development and therefore emission development is different than expected at the time the target is set. - The environmental outcome is uncertain		
Discussion	Strengths		Weaknesses
	- Provides flexibility and avoids high costs in case of unexpected developments - Makes participation of many countries easier - Relatively minor adjustment to the existing Kyoto system - Compatible with Kyoto system (reporting and with adoptions also with the mechanisms) - Can be seen as a support mechanisms for developing country action		- Reduce certainty on the global emission level, environmental effectiveness not guaranteed - Such targets are difficult to set to balance the effort and incentive - Unclear how companies of such a country could trade before the country has decided whether to comply or not, to avoid overselling
Perceived Positions	Least developed countries	+	Likely to welcome such target
	India	+	Likely to welcome such target
	China	+	Likely to welcome such target
	Advanced developing countries	+	Advanced developing countries are likely to prefer these types of targets over binding absolute targets.
	Group of 77	+	Most developing countries are likely to prefer these types of targets over binding absolute targets.
	Russia	0	Unknown position
	USA	0	Such targets for some developing countries would need to be set at a level that requires sufficient domestic action.
	Japan	0	Such targets for some developing countries would need to be set at a level that requires some domestic action.
	Other umbrella group countries	0	Such targets for some developing countries would need to be set at a level that requires some domestic action.
	EU	0	Such targets for some developing countries would need to be set at a level that requires some domestic action.
Overall assessment	"No lose" targets would provide a good incentive for countries to start participating with emission targets.		
Variants of the approach	- Dynamic "no lose" targets "No lose" targets (fixed or dynamic) for sectors instead for countries as a whole		

References*Exclusively on this approach*

- Philibert, C., 2000: "How emissions trading could benefit developing countries" *Energy Policy* 28: 947-956

Comparing the approach to other approaches

- Baumert, K.A.; O. Blanchard ; S. Llosa ; J.F. Perkaus (2002) „Building on the Kyoto Protocol, options for protecting the climate“
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Fact Sheet 12: Sector targets

Name	Sector targets		
Description	- Targets are defined for selected sectors - Sector targets can be defined either equally on a global level or only for individual newly joining countries. - Sector targets can be binding or “no lose”/positively binding targets - Sector targets can be absolute caps or dynamic described as function of unit of output (e.g. CO₂/t steel)		
Implications	- Efficiencies (e.g. CO₂/t steel) vary substantially between countries. Annex I country productions are not necessarily scoring better compared to Non-Annex I countries. - Sector targets on the national level for selected countries could be an incentive to take on a target, especially if it is “no lose” and dynamic		
Discussion	Strengths	Weaknesses	
	- Provides focus on most important sectors and particular reduction options - If dynamic, provides flexibility and allows for growth in production - Makes participation of many selected sectors and consequently of countries easier - If applied equally globally, decreases competitiveness concerns - Can be build into the Kyoto system	- Requires detailed sectoral information, which is currently only available for selected countries and sectors - Require careful target setting - Reduce certainty on the global emission level, environmental effectiveness not guaranteed since increases in production volumes (and thus GHG emissions) are possible and not all emissions are covered	
Perceived Positions	Least developed countries	+	Most likely exempt.
	India	0	Would not assume a sectoral target, but would not disagree if others take one.
	China	0	Would not assume a sectoral target, but would not disagree if others take one.
	Advanced developing countries	+	Would prefer sectoral targets over absolute targets.
	Group of 77	+	As group could be positive.
	Russia	-	Is currently less efficient than most countries.
	USA	+	Could possibly prefer this alternative if sectoral targets are applied globally.
	Japan	+	Would prefer that sectoral targets are applied globally, as current efficiency is high.
	Other umbrella group countries	+	Unknown position. Probably same as Japan.
	EU	+	Likely to be able to agree to sectoral targets for some newly participating countries.
Overall assessment	- Sector targets could provide a good incentive for countries to start participating with emission targets - Applied globally could decrease competitiveness concerns - May currently receive high attention because different groups interpret “sectoral targets” differently		
Variants of the approach	Höhne et al. 2003 propose “performance targets”, that define an amount of allowed emissions per unit of activity (e.g. emissions per tonne of steel or per head of cattle). These individual targets are aggregated to one total national target.		

References*Exclusively on the approach*

- Schmidt, J.; Helme, N.; Lee, J., 2005: „Straw“ Sector Proposals - Working Documents for participants in the CCAP Future Action Dialog

Comparing the approach to other approaches

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http://arch.rivm.nl/iweb/iweb/Reports/728%20001%20023_final_V1.pdf
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<http://www.umweltbundesamt.org/fpdf-l/2246.pdf>, page 63

Fact Sheet 13: Extended CDM

Name	Extended CDM		
Description	• Proposal for accounting for emission reductions as result of implementing sector policies in developing countries. • Developing countries are responsible for defining and agreeing new sector policy as well as for implementing suitable sector wide emission reduction projects. Any reductions are the responsibility of the country. • The boundary for an emission reduction activity would be the entire sector of a country. • The level of emission reduction credits generated would be calculated as the difference between the sector's baseline level (emission level without the introduction of the specific sector policy) and the actual levels. • Sales of emission reductions can take place after the emission reductions are verified by an independent entity that confirms compliance with the sector policy and its defined targets.		
Implications	• The option to sell reductions is an incentive to participate • The link to CDM ensures that reductions are real • Simplification of the project by project CDM • Avoiding leakage compared to project by project CDM		
Discussion	Strengths	Weaknesses	
	• Voluntary nature is incentive to take on commitment • Can be used as a stepping stone for binding targets • Avoids "hot air" • Simplification of the CDM	• Environmental effectiveness not guaranteed • Strength of incentive dependant on price of CERs • Requires detailed review of work in progress of implementing the sector policies • Cumbersome procedure if the baseline is set through the executive board of the CDM	
Perceived Positions	Least developed countries	+	Would welcome the idea
	India	+	Could welcome the idea
	China	+	Would be in line with Chinas claim, that emission reductions have to be (co-)financed from outside
	Advanced developing countries	+	South Korea proposed a similar option. Likely to prefer this approach over a fixed binding target.
	Group of 77	+	Could be open to the idea
	Russia	0	No position known.
	USA	-	No position known, but full payments for developing country action may receive opposition
	Japan	-	No position known, but full payments for developing country action may receive opposition
	Other umbrella group countries	0	No position known
	EU	+	Could be accept the idea if applied for a selected number of developing countries
Overall assessment	• May have a cumbersome procedure to set the baseline through the executive board. A "no lose" target (allowing sales if target is overachieved, but no penalties if not achieved,) for all or selected sectors would therefore be preferred, as it covers all advantages but be much simpler to implement.		
Variants of the approach	• The element of the approach, that developing country action is financed by developed countries, is very similar to the basic idea of the "commitment to human development with low emissions" and to "no lose" targets • One variant would be the linkage to intensity targets for advanced developing countries (Rae-Kwon Chung 2003). Here only the reductions that go beyond the intensity target can be sold.		

References

Exclusively on the approach:

- J. Samaniego and C. Figueres, 2002: "Evolving to a sector based Clean Development Mechanism", in K. Baumert (ed.), "Building on the Kyoto Protocol, Options for protecting the climate", World resources Institute, Washington, USA, http://pubs.wri.org/pubs_pdf.cfm?PubID=3762
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Fact Sheet 14: Dual targets

Name		Dual targets	
Description		Two targets are defined, a “selling target”, below which emission rights can be sold, and a “buying target”, above which emission right have to be bought (Philibert & Pershing, 2001; Kim and Baumert, 2002).	
Implications		Aim to take into account the uncertainty in future emissions.	
Discussion		Strengths	Weaknesses
		- Provide flexibility and avoid high costs due to unexpected developments - Relatively minor adjustments to the existing Kyoto system - First step for newly participating countries	- Reduces certainty on the global emission level, environmental effectiveness only guaranteed within a bandwidth - Such targets are difficult to set, as two targets are to be defined
Perceived Positions	Least developed countries	+	Would be exempt
	India	0	Unknown position. Unlikely to accept such target
	China	+	Unknown position. Possibly open to discuss such target
	Advanced developing countries	+	Unknown position, but advanced developing countries are likely to prefer these types of targets over binding absolute targets.
	Group of 77	+	Unknown position. Could be open to discuss such a target
	Russia	0	Unknown position.
	USA	+	Unclear position but might welcome this type of developing country involvement.
	Japan	+	Unclear position but might welcome this type of developing country involvement.
	Other umbrella group countries	+	Unclear position but might welcome this type of developing country involvement.
	EU	+	Unclear position but might welcome this type of developing country involvement.
Overall assessment		If uncertainty of economic development prevents setting an absolute binding target, then dual targets could be applied.	
Variants of the approach		None	
References		<i>Exclusively on the approach</i> Y. Kim and K. Baumert 2002 “Reducing uncertainty through dual intensity targets”, in K. Baumert (ed.), “Building on the Kyoto Protocol, Options for protecting the climate”, World resources Institute, Washington, USA, http://pubs.wri.org/pubs_pdf.cfm?PubID=3762 <i>Comparing this approach to others</i> - Philibert, Cédric, Jonathan Pershing, 2001: “Considering the Options: Climate Targets for All Countries”, Climate Policy 1, 211-227	

Fact Sheet 15: Price Caps

Name		Price caps	
Description		An unlimited number of additional emission rights is provided at a given price in an emission trading system	
Implications		- Aim at providing more flexibility to the countries, so that high costs are avoided if the economic development, relative energy price changes and/or technology development, and therefore emission development, is different than expected at the time the target is set. - A price cap can best be applied to all countries participating in the trading system. Applying it only to a subset of countries would require a rule preventing countries "using" the price cap to be net sellers - The revenue from selling additional emission rights can be used to finance additional emission reduction projects, R&D activities or adaptation	
Discussion		Strengths	Weaknesses
		- Avoids high costs for countries - Relatively minor adjustments to the existing Kyoto system	- Reduce certainty on the global emission level, environmental effectiveness not guaranteed - To be effective the price should be high enough and this can make it costly for specific countries - If applied to a subset of countries, requires a rule to prevent overselling
Perceived Positions	Least developed countries	+	Would be exempt
	India	-	Unlikely to accept such a target
	China	-	Unlikely to accept such a target
	Advanced developing countries	0	Could be open to the idea
	Group of 77	-	Unlikely to accept such a target
	Russia	0	Unknown position
	USA	+	Could possibly help them to take on a binding emission target
	Japan	+	Could possibly help them to take on a binding emission target
	Other umbrella group countries	+	Could possibly help them to take on a binding emission target
	EU	+	Would not object the concept if helps countries to join and if set at a reasonably high level
Overall assessment		- If uncertainty of economic development or of abatement costs prevents setting a binding target, then price caps could be applied to overcome this barrier. - If it should be applied only to a subset of countries, "no lose" targets and dual targets could be chosen as alternative	
Variants of the approach		None	
References		<i>Exclusively on the approach</i> - Pizer, W., 2002: Combining Price and Quantity Control to Mitigate Global Climate Change, <i>Journal of Public Economics</i>, 85: 409-434 - Henry D. Jacoby; Ellerman, A.D. (2004): The safety valve and climate policy <i>Energy Policy</i>, Volume 32, Issue 4, March 2004, Pages 481-491 <i>Comparing this approach with others</i> - International Energy Agency 2002, "Beyond Kyoto -- Energy Dynamics and Climate Stabilisation", ISBN 92-64-19838-5 - Philibert, C., 2004: Lessons from the Kyoto Protocol: Implications for the Future <i>International Review of Environmental Strategies</i>, 5(1): 311-322	

III. Other Approaches

In addition to the discussed approaches and targets, there are also a number of new approaches or new ideas. The attached information is meant to keep track of those less commonly discussed approaches – in most cases presenting specific features of a future climate regime.

i. Approaches for setting national targets

Action targets

An action target is a commitment to reduce GHG emission levels by an agreed percentage. This target is applied to a projected baseline, namely emissions during the commitment period (Goldberg and Baumert 2004). A country would have to prove e.g. for 2015 that it this year reduced 2% of its projected emissions. It could either purchase emission allowances on the market of that magnitude or show that its emissions were reduced due to actions undertaken.

The advantage is that the level of effort is less dependent on the future development of emissions. Its absolute magnitude is a function of the final emissions. Framing the issue in terms of action may also be conducive in allowing more countries to participate. The disadvantage is the difficulty in calculating the level of emission reductions that would have occurred in the absence of the action, essentially an ex-post baseline.

Investment targets

If an international agreement is based on investment targets, countries agree upon certain expenditure in the framework of greenhouse gas emission reduction policies. Countries could for instance agree upon spending a certain fraction of GDP (the fraction may increase with increasing GDP per capita). The expenditures could include government investment schemes (e.g. in forestry), investment subsidies (e.g. for energy efficiency improvement), feed-in tariffs (e.g. for renewable energy), support of R&D activities and awareness campaigns. Countries may also be allowed to spend part of the money in other countries through CDM schemes or direct investments.

The advantage of an investment target is that there is a clear link to the ability-to-pay of countries. Governments would have full control over the compliance with their targets (which may not always be the case with a target expressed in emissions). A disadvantage is that the environmental outcome is highly uncertain as various types of expenditure strongly differ in emission reduction per unit spent. Thus cost-effectiveness is not achieved. Furthermore, auditing may encounter difficulties.

ii. Approaches for cross-national activities

Sector wide agreements

UNFCCC negotiations could be instrumental in developing sector-wide agreements between all companies active in a particular sector, e.g. all car manufacturers or all cement producers.

An advantage is that the international sector-wide agreement prevents any competitive disadvantage for any company. Disadvantage: liability and enforcement would not be with governments.

Agreements on technology cooperation

Countries might agree upon jointly to develop and implement specific technologies. They would invest together in research and development activities and agree how these technologies would be employed.

An advantage is that this approach would gather likeminded countries with common interests. On the other hand the approach alone is geared towards the emission reduction in the long term and does not affect short term emissions.

Agreements on policies and measures

Instead of setting national emission targets, countries (or groups of countries) might also agree upon the joint implementation of policies and measures. Such policies and measures could include for instance standards for car CO₂ emissions (comparable to the voluntary agreement with the car-industry in the EU), a renewable energy obligation or a CO₂ tax.

As in the previous one, an advantage is that the international sector wide agreement prevents any competitive disadvantage for any company. A disadvantage is the greater need for monitoring, the problem of ensuring compliance and the difficulty to choose the most cost effective approach.

Greening investment flows

There are already large investment flows from industrialised countries to developing countries. These include direct foreign investment and investments supported by governments, e.g. through export credit agencies. These flows are much larger than any flow expected under the CDM. The “greening” of these investment flows means that environmental criteria are set for these investments to be eligible for government support. (Sussman and Helm 2004, Barrett 2003, Edmonds and Wise 1999, Philibert 2004)

The advantage is that the impact can be much bigger than that of (current) schemes under the climate protocol. A problem is that this approach enters other policy fields with will further complicate negotiations.

iii. Procedural approaches

Agreements in steps

An alternative to reaching an agreement for all the countries in one go, is to reach agreement in two steps. First, an agreement on commitments needs to be reached per region (or other country grouping). Second, within the region (or other country grouping) the commitments are distributed over the individual countries in the grouping, according to a key to be agreed by themselves.

A historic example of such an approach is the European Union burden sharing, where the EU Member States agreed upon a EU internal differentiation scheme, independent of the way differentiation within in Annex I was agreed.

An advantage is that some country groupings are given more flexibility to select the type of targets they want. A possible pitfall is that negotiations take place on two levels and that countries may not agree upon the worldwide level if the regional negotiations have not been finished and vice versa.

Exclude the energy and industry sector from national targets

There are some sectors that develop strongly, and more dependent on international markets than on national policies, such as the electricity production sector and the energy-intensive manufacturing industries. It could be considered to take these sectors out of the national targets and give them a certain total emission target all together that could be attained through an emission trading system. The remaining emissions (at least for carbon dioxide) mainly emerge from the buildings sector and the transport sector.

An advantage of this approach is that an important source of differences in national circumstances is taken out of the agreement on national commitments. A disadvantage is that the problem is partly replaced by the emission allocation within the emission trading scheme. Furthermore, this is not a solution for other types of emissions that are strongly differing in national circumstances, e.g. those from agriculture and land-use change.

iv. Extensions of the agreements

Include other radiative forcing agents

The Kyoto-Protocol only covers six greenhouse gases that show radiative forcing. However, substantial sources of radiative forcing are tropospheric ozone and black carbon. For both, increased atmospheric concentrations are to a substantial part caused by human activities (ozone mainly through the emissions of nitrogen oxides and volatile organic compounds). A complication is that there are also human-induced radiative forcings that are negative (e.g. as a result of SO₂ emissions).

Agreements could be reached to reduce concentrations of these substances below levels that are already stipulated (out of health concerns) in a number of world regions.

An advantage of including these substances is that the lifetime is short and that emission reduction will fairly rapidly lead to reduction in forcing (and hence partly compensating for the increase of radiative forcing through gases covered by the Kyoto Protocol). An important difficulty is that the gases are not well-mixed, leading to effects that depend on the location of emissions. Furthermore, there are no straightforward relations between emissions and concentrations (and substantial scientific uncertainties on these relations), and the handling of substances with negative radiative forcing is challenging.

Merge air pollution and climate agreements

Many emission sources are responsible for both regional air pollution emissions and emissions that may cause climate change. Many emission reduction measures have an influence on both types of emissions. It might be worth considering integration of both types of agreements. This could be done either on a world or a regional level.

An advantage is that the total amount of emission reductions can be attained at lower costs. A disadvantage is that both types of effects have different scales (regional/continental versus global). Merging both negotiation arenas may complicate decision-making.

IV. Conclusions

In this chapter we have seen that there is a variety of approaches available to design a future international climate change agreement. It seems likely that a stages system receives the most support. It could include several types of targets, where the sectoral and several flexible targets seem to be promising options. The following sections of this report will build on this analysis.

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4. Elements of a Possible Future Regime

I. Introduction

The previous chapters have dealt with the analytical aspects of climate change mitigation options. This chapter attempts to assemble the key elements for agreement in a Post-2012 framework.

The challenge is that countries differ in many respects: their level of economic activity, economic structure, energy efficiency levels, current energy sources and access to energy sources, land-use patterns as well as a number of other national circumstances. The elements should therefore be flexible and collectively offer “something for everyone”, but they must retain a number of key criteria.

First and foremost the future climate regime must fill a number of environmental criteria, including the stabilization of greenhouse gas emissions, synergy with sustainable development, and incentives for innovation and early action. It must also reflect common but differentiated responsibilities and cover a broad range of countries, from the USA to developing countries. It must also fill a number of economic criteria and ability to pay issues and resolve technical, institutional and general policy criteria.

Keeping these issues in mind, we can differentiate four key elements that a future regime could encompass:

- Multi-stage agreement on emission reductions of Kyoto-gases (excluding LULUCF)
- Agreement on LULUCF/deforestation
- Agreement on adaptation
- Agreement on technology

These are explored further in the sections below with a number of possibilities proposed per element. The final section provides a consolidated recommendation on which to base negotiations upon. Other elements that were already included in the Kyoto Protocol will most likely also be part of future agreements, like the use of flexibility mechanisms, monitoring, etc. but they will not be discussed here further, as they can be expected to be less challenging than those detailed below.

II. Multi-stage approach

The first element of an international agreement on climate change would aim at emission reductions in the participating countries. The current system under the UNFCCC and the Kyoto Protocol is based on two stages, Annex I and Non-Annex I, with respective commitments. It seems likely that in the future this differentiation in two groups may not be sufficient to take into account the differences between countries to a full extent. Several authors (Gupta 1998, 2003, Berk and Den Elzen 2001, Den Elzen et al. 2003, Höhne et al. 2003, 2005, Criqui et al. 2003, Ott et al. 2004) have proposed that further stages are introduced in between Annex I and Non-Annex I and that countries gradually move through these stages with increasing stringency. This approach would reflect that countries today have different levels of economic development and therefore have different obligations under a future climate treaty.

i. Concept of different stages

Figure 15 below graphically presents the idealised development of emissions for countries at different stages of development under an emission reduction agreement. In their early stage of development countries increase their emissions per capita (Section C in Figure 15) due to industrialization and the creation of additional physical infrastructure. Under an emission reduction agreement they would have to be able to increase their emissions. In a second phase (B), countries that have reached a certain level of development would need to stabilize emissions per capita as the industrialization is to a large extent completed and/or efficiency gains are as fast as the growth in production. Finally, countries at highest development need to reduce their per capita emissions by making the economy more energy and emission efficient (A). For example, emissions per capita of China and India are increasing rapidly and would be allowed to increase under an emission reduction agreement, these countries are in phase 1. At the other extreme, there are most of the Annex I countries that have already agreed upon emission reductions.

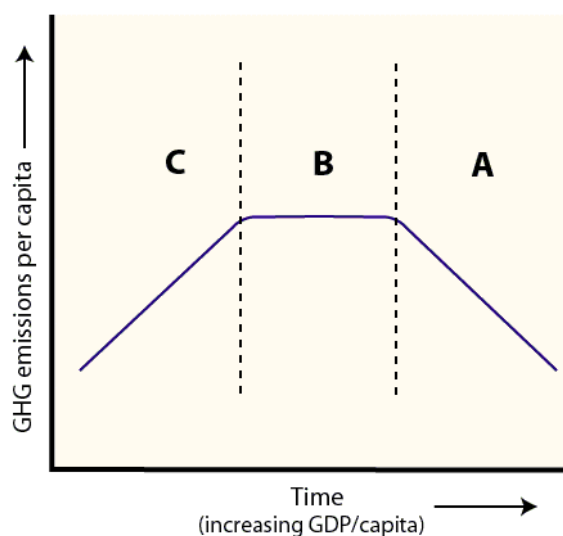
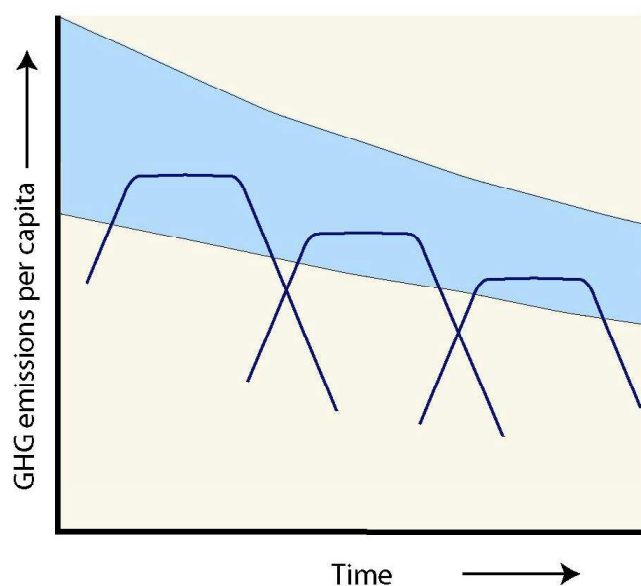


Figure 15: The basic idea behind the multi-stage approach: in their early stage of development countries increase their emissions per capita (A), then level out (B), and then finally subsequently decline (C)

Individual countries undergo such development earlier or later, depending on the stage of development they are in today. Figure 16 shows the schematic development for three countries that develop one after the other. Those countries that started later with the industrialization, will reach a maximum of per capita emissions at a lower level, because the technology develops. Rapidly industrializing countries such as South Korea use relatively efficient technology for their industrial production facilities and do not have to undergo the development using first less efficient technologies such as the UK or the USA.

Figure 16: Progression of per capita emissions in a country's developmental cycle for countries that develop at different moments



A staged emission reduction agreement would be based on this concept. Countries that have reached the maximum (phase A) need to reduce their emissions. Countries that are at the maximum (phase B) do not further increase emissions. Countries that are still developing (phase C) are allowed to increase emissions. The threshold for participation declines with time (shaded band in Figure 16), as technology gets more efficient.

Such a multistage setting may result in a relatively complicated system, as many decisions have to be taken regarding:

- the thresholds for participation
- the different types of commitments in the stages
- the differentiation of the stringency of the commitments
- the differentiation of targets

In the following sections we will discuss the possibilities to be able to present one concrete elaboration at the end of this section.

ii. Participation

For a staged approach one has to define, which countries are in the different stages. The starting point for grouping countries is to assess their characteristics and to define what stage they best correspond to. A country is invited to move into the next stage when it exceeds a certain threshold. Three groups of countries (if necessary four) could with a more or less automatic transition move through thresholds expressed in terms of emissions per capita, GDP per capita or other indicators.

A review of countries sorted by emissions per capita is presented in Figure 17. The figure highlights the top twenty greenhouse gas emitting countries and their relation to other countries.

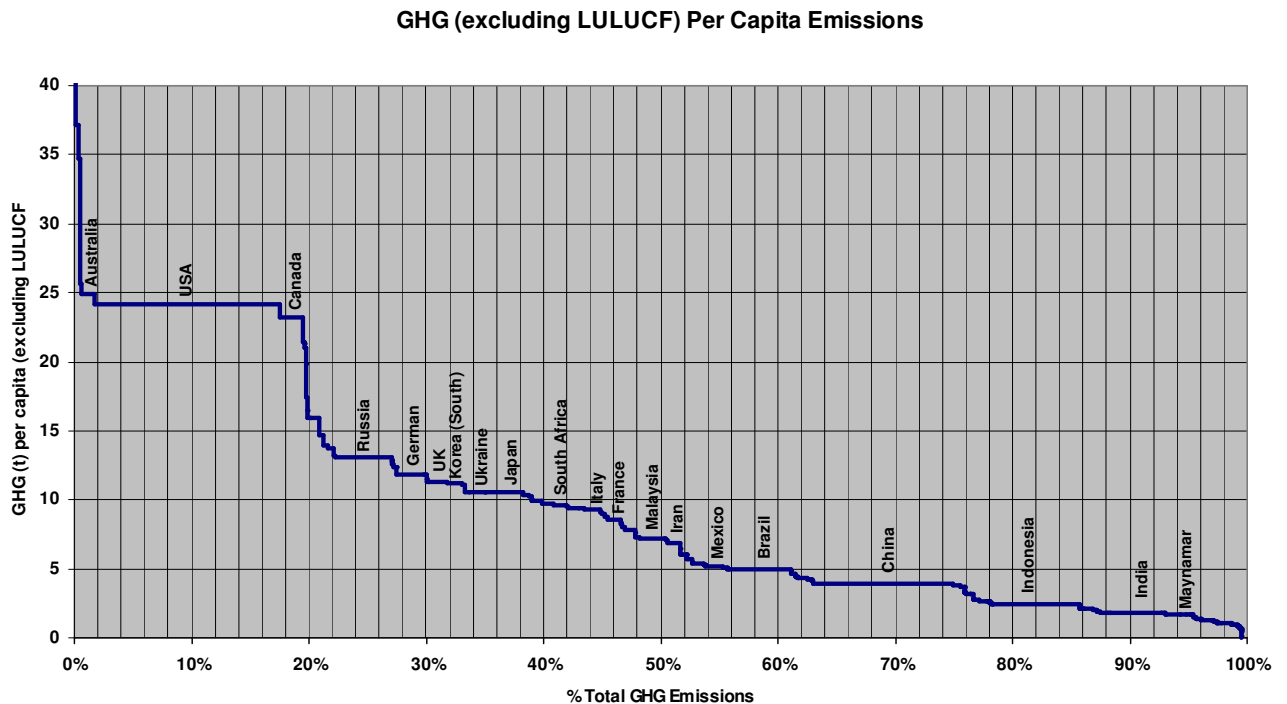


Figure 17: GHG emissions per capita (CAIT v1.5, 2000)

A further way to differentiate countries would be according to their state of development. For countries in an early stage of development it is difficult to spend resources on greenhouse gas emissions reductions. Indicators for the state of development are the Human Development Index as indicator or the ability to pay, e.g. using GDP per capita as indicator. The Human Development Index is the aggregate of three indicators: standard of living, as measured by real GNP per capita (PPP\$), life expectancy at birth, and educational attainment, as measured by a weighted average of adult literacy (two-thirds weight) and enrolment ratio (one-third weight). Figure 18 shows the correlation between the HDI and GDP per capita. We can see that GDP per capita is a well approximation of the HDI, partly because it is one of its input variables. We also see that there is a significant number of countries, whose GDP per capita (PPP) figures are below \$4000 US. Correspondingly, their Human Development Index (HDI) score lags behind the world as well.

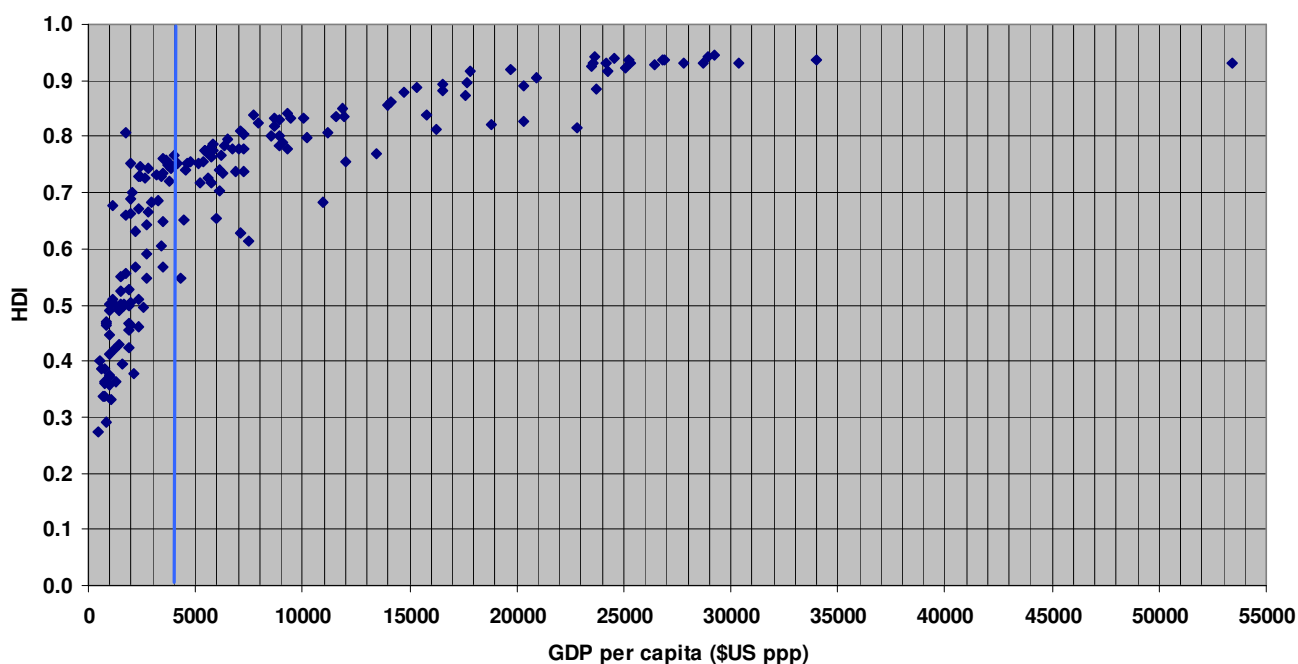


Figure 18: Human Development Index (HDI) versus GDP per capita (CAIT v1.5, 2000)

Hence, we use here the two parameters emission per capita (excluding land use change) and GDP per capita (in purchase power parities) to represent the main characteristics of countries (similar to Criqui et al. 2003 and Gupta 2003). Plotting both indicators in one figure results in the figure shown in Figure 19. The highlighted countries comprise the top thirty greenhouse gas emitting countries.

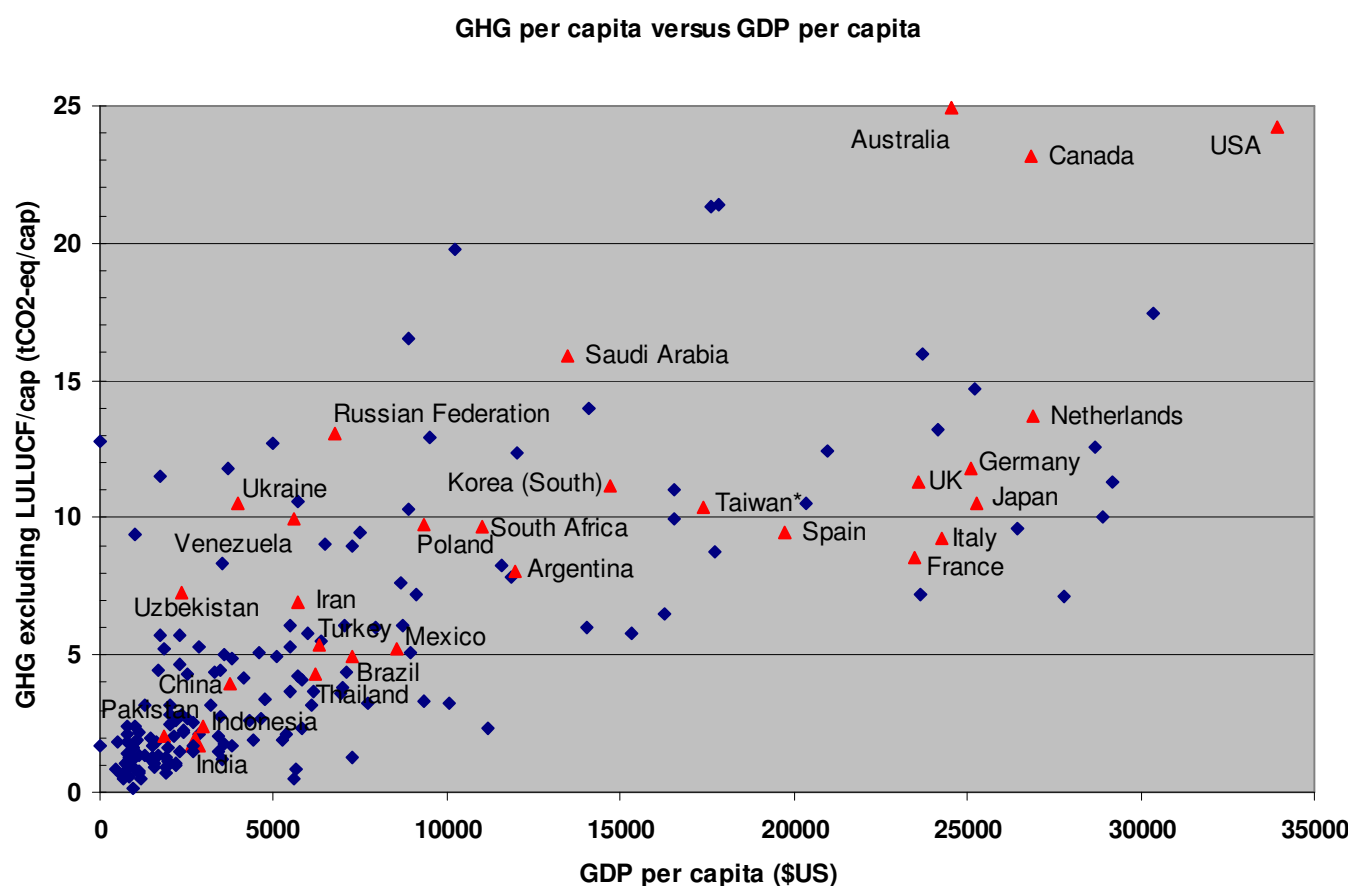


Figure 19: Emissions per capita vs. GDP per capita highlighting the top 30 greenhouse gas (excluding LULUCF) emitting countries (CAIT v1.5, 2000)

Using the two indicators one can define a number of cut-offs or thresholds for participation of countries at particular stages, which are presented in Figure 20. The first option would be a GHG per capita level and GDP per capita level (horizontal and vertical lines in Figure 20). One could also add the two indicators with weighting factors (diagonal straight line in Figure 20 as used by Criqui et al. 2003). Furthermore, the two indicators could be weighted and multiplied (hyperbolic line in Figure 20). These cut-offs will most likely be used as a starting point for negotiations, so there will always be some element of flexibility (according to other national circumstances, for instance).

It seems unlikely that one threshold method (selection of indicators and combining them to one index) would satisfy all countries particular concerns. One could therefore aim to first apply a simple threshold method (GHG/cap and GDP/cap) and leave room in the negotiations to make exceptions.

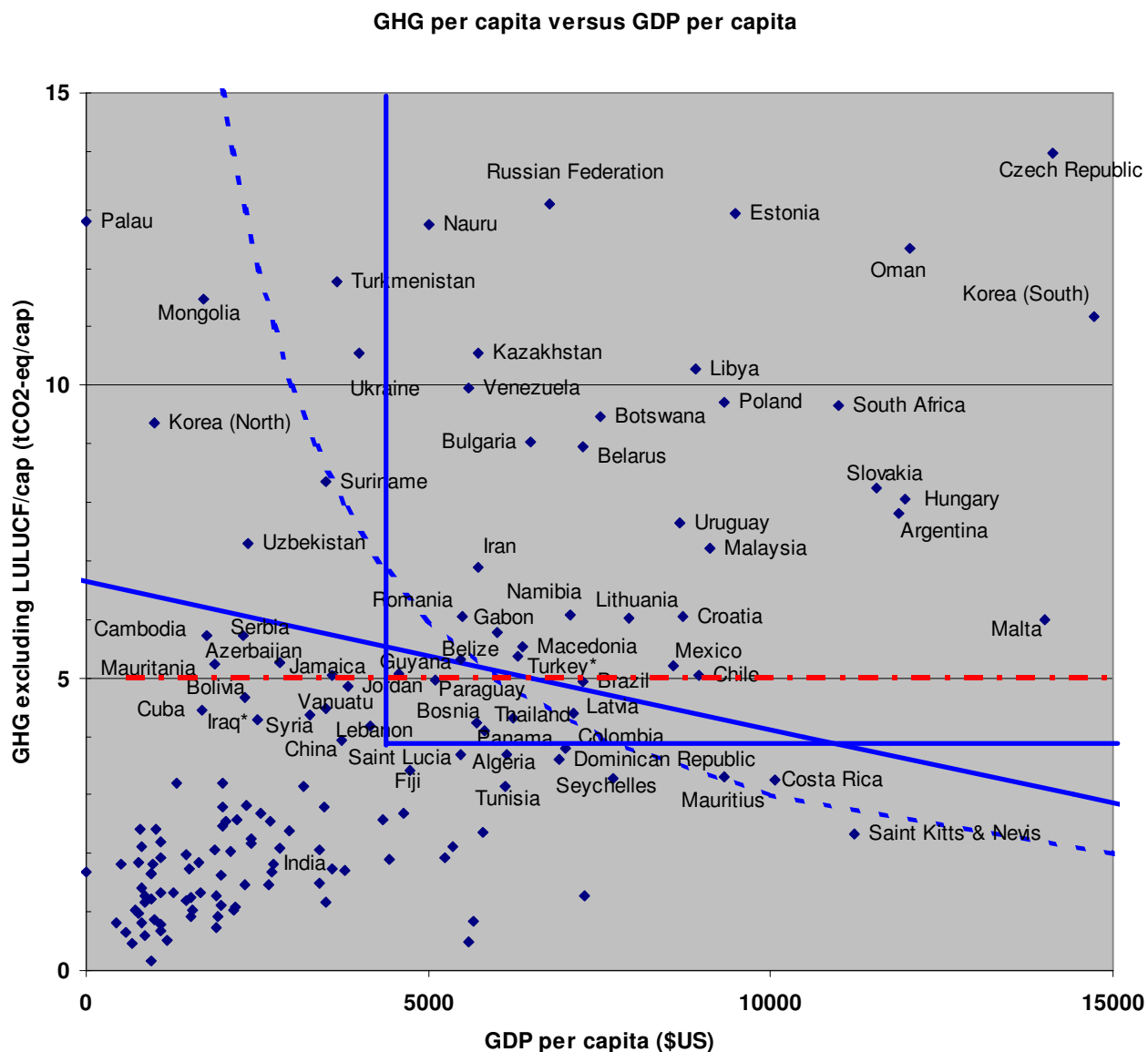


Figure 20: GHG per capita versus GDP per capita showing various methods of establishing cut-off levels. All thresholds shown here would include the same share of worldwide emissions (60%) with a slightly different selection of countries (see also following figure) (CAIT v1.5, 2000)

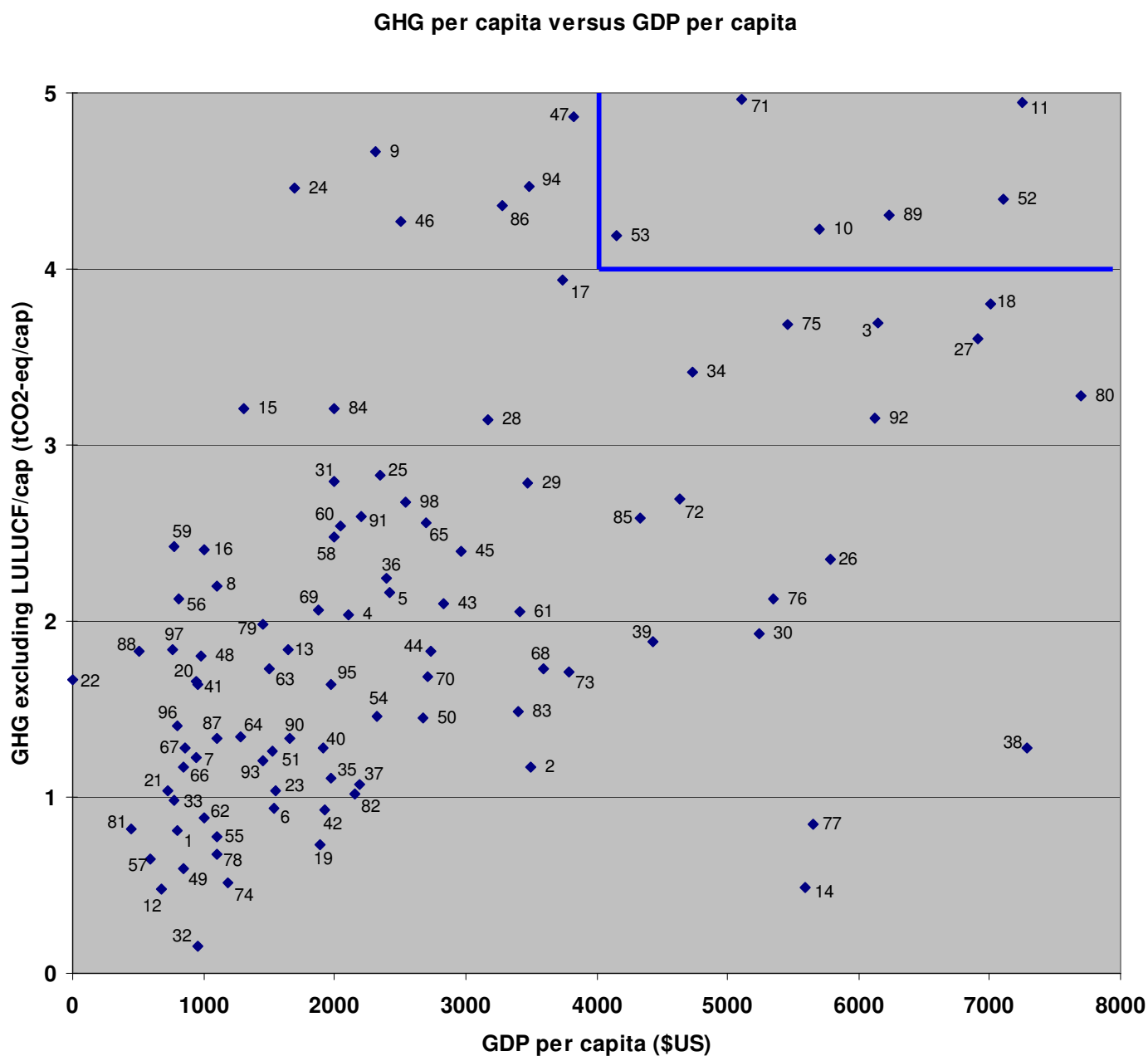


Figure 21: GHG per capita versus GDP per capita showing various methods of establishing cut-off levels for countries with low GDP per capita and GHG excluding LULUCF (see following table for the key to all country names) (CAIT v1.5, 2000)

Table 11: Key to countries presented in Figure 21

#	Country	#	Country	#	Country	#	Country	#	Country
1	Afghanistan	21	Congo, Dem. Rep	41	Guinea-Bissau	61	Morocco	81	Sierra Leone
2	Albania	22	Cook Islands	42	Haiti	62	Mozambique	82	Solomon Islands
3	Algeria	23	Côte d'Ivoire	43	Honduras	63	Myanmar	83	Sri Lanka
4	Angola	24	Cuba	44	India	64	Nepal	84	Sudan
5	Armenia	25	Djibouti	45	Indonesia	65	Nicaragua	85	Swaziland
6	Bangladesh	26	Dominica	46	Iraq*	66	Niger	86	Syria
7	Benin	27	Dominican Rep	47	Jordan	67	Nigeria	87	Tajikistan
8	Bhutan	28	Ecuador	48	Kenya	68	Niue	88	Tanzania
9	Bolivia	29	Egypt	49	Kiribati	69	Pakistan	89	Thailand
10	Bosnia & Herzegovina	30	El Salvador	50	Kyrgyzstan	70	Papua New Guinea	90	Togo
11	Brazil	31	Equatorial Guinea	51	Laos	71	Paraguay	91	Tonga
12	Burundi	32	Eritrea	52	Latvia	72	Peru	92	Tunisia
13	Cameroon	33	Ethiopia	53	Lebanon	73	Philippines	93	Uganda
14	Cape Verde	34	Fiji	54	Lesotho	74	Rwanda	94	Vanuatu
15	Central African Rep	35	Gambia	55	Liberia*	75	Saint Lucia	95	Vietnam
16	Chad	36	Georgia	56	Madagascar	76	St Vincent & Gren	96	Yemen
17	China	37	Ghana	57	Malawi	77	Samoa	97	Zambia
18	Colombia	38	Grenada	58	Maldives	78	Sao Tome & Principe	98	Zimbabwe
19	Comoros	39	Guatemala	59	Mali	79	Senegal		
20	Congo	40	Guinea	60	Moldova	80	Seychelles		

iii. Types of commitments for the stages

Options for mitigation commitments for reaching the required emission reductions could take several forms in the different stages. Currently, Annex I countries under the Kyoto Protocol have legally binding emission limitation or reduction commitments. Non-Annex I countries have more general commitments but no quantified emission targets.

Countries in stage A of the multi stage agreement could assume the most prominent type of commitment, the binding absolute emission reduction targets as included in the Kyoto Protocol for Annex I countries. Such targets provide certainty about future emission levels of the participating countries (assuming targets will be met). The target can be reached in a flexible manner across greenhouse gases and sectors as well as across borders through emission trading and/or project based mechanisms (Joint Implementation and the clean development mechanism). These targets could be applied for Annex I as well as Non-Annex I countries in the future. However, several Non-Annex I countries, as well as the USA, have expressed their concerns about the absolute targets being too rigid and capping economic growth. Also Japan may not be in favour of absolute caps.

Differentiation of emission reduction targets can be made through several methods, including convergence of per capita emissions, historic responsibility ("Brazilian proposal"), ability to pay (GDP/cap), and sectoral approaches such as the Triptych approach and multi-sector convergence. See Chapter 3 for further elaboration on these approaches.

Countries in stage B or for some exceptions in stage B could take on flexible emission targets, including the following options:

- *Non-binding emission targets*, meaning that not reaching them has no consequences. Here emission trading could not be applied.
- *"No lose" or "positively binding" emission targets*, meaning that additional emission rights can be sold, if the target is reached, but no additional emission rights have to be bought, if no rights have been sold and the target is still not met.
- *"Dual" targets*, meaning that two targets are defined, a "selling target", below which emission rights can be sold, and a "buying target", above which emission rights have to be bought
- *"Price cap"*, meaning that an unlimited number of additional emission rights is provided at a given maximum price

- *Dynamic targets*, meaning that targets are expressed as dynamic variables as a function of the GDP ("intensity targets") or variables of physical production (e.g. emissions per tonne of steel produced).
- *Sectoral targets*, meaning emission reduction targets that apply for one sector only, instead of to whole economy.
- Adopt sustainable development policies and measures

All of these options aim at providing more flexibility to the countries, to avoid extremely high costs, if the economic development and therefore emission development is different than expected at the time of setting the target. Providing this flexibility reduces the certainty that a given emission level is really reached. The increased certainty in costs is traded against an increased uncertainty in the total resulting emissions.

These types of targets could be assumed by countries newly entering the regime, or by those countries that have clear objections to the absolute binding emission reduction targets (e.g. the USA). Of the options listed above, the more flexible targets like the "no lose" targets, dual targets or price caps, could be particularly attractive for newly entering countries. Sectoral targets also have their advantages as they can be focussed on a limited part of the national economy. Dynamic targets represented as emissions per unit of product could be attractive for the USA.

Another option particularly for newly entering developing countries would be the commitment to adopt sustainable development policies and measures (Winkler et al. in WRI 2002). In this approach, development objectives are formulated first. In a second step, it is considered how climate policies can support these development goals. This approach is very attractive to developing countries as it focuses on their main concern of (sustainable) development. The major difficulty lies in the assessment of whether these activities are additional to what would have happened otherwise, whether the country is showing action. This approach is seen as a possible first step for Non-Annex I countries into more comprehensive action.

Countries in stage C would on the one hand receive assistance of developed countries to limiting their emissions and on the other hand enter into agreements to limit emissions in selected areas. One option would be through funds and technology transfer. Such funds would finance emissions reduction projects or adaptation activities. The current system of the UNFCCC and the Kyoto Protocol already includes some funds and project activities, but contributions to and participation in those are mostly voluntary. It also includes provisions for technology transfer, but volumes of financial flows are not defined. A second option for commitments for developed countries that aim at limiting emissions in developing countries would be the "greening of investment flows" (CCAP 2004). These are those flows of resources that are currently transferred from developed to developing countries through development banks and export credit agencies. These amount to much larger volume of funds than the total volume estimated to be involved in the CDM. Formulating conditions directing these resource flows towards low greenhouse gas emitting technology would be a substantial opportunity to limit future emission growth in Non-Annex I countries. Enhancing CDM to allow sectoral government programmes to be eligible CDM projects could be a further option. Comprehensive climate change action would be rewarded (in part) as emission reduction credits that can be sold on the market.

Also for this group, a possible agreement on emission limitation could be in the form of so-called sectoral agreements. For selected sectors the countries could bind themselves to limit emissions in these areas. Given the relatively high growth rates of countries in Group C, and the associated uncertainties in these growth rates, intensity targets seem to be most appropriate: agreements could be reached on the emissions per unit of activity, where activity is measured in physical terms (e.g. kWh produced, tons of steel produced). Sectors that are primary candidates are the electricity sector, the energy-intensive industry and maybe also the transport sector. For these sectors greenhouse gas emission limitation is strongly connected to issues relevant for development and sustainability, including improvement of competitiveness, security of energy supply and local air quality.

iv. A complete multistage system

In the following section we describe - as example to clarify the concept - one possible variant of a staged system and provide the variables that would allow this system to be compatible with the environmental long-term goal of the European Union. It is summarized in Table 12.

The European Union has repeatedly stated that "global average temperatures should not exceed 2 degrees Celsius above pre-industrial level". For the purpose of this analysis we assume that this means

that CO₂ concentration should stay below 450 ppmv (at average climate sensitivity). For further analysis on this issue see Eickhout et al. 2003, Wigley et al. 2005, Meinshausen et al. 2005, Den Elzen and Meinshausen 2005.

Table 12: Multi-stage emission reduction agreement: country groupings and targets

Group	Criterion for participation in 2020 (cut-offs based on today's levels, indicative)	Ambition level of commitments in 2020	Types of targets	Differentiation of targets
A	Annex I countries and countries with GHG emissions larger than 9 tCO ₂ -eq/cap, i.e. 2/3 of current Annex I average and excluding countries with less than US\$4000/capita GDP	15% to 30% average reduction from 1990	Absolute emission reduction targets	Sectoral burden differentiation approach, such as Triptych
B	GHG emissions 5 - 9 tCO ₂ -eq/cap, i.e. between 1/3 and 2/3 of current Annex I average excluding countries with less than US\$4000/capita GDP	Per capita stabilization 2010 to 2020	Dual targets or price caps Alternatively: sectoral targets for important sectors	Individual target setting
C	GHG emissions less than 5 tCO ₂ -eq/cap and all countries with less than US\$4000/capita GDP	Emission limitation efforts, which result in possibly 5% below reference (BAU)	No binding overall targets but sectoral agreements (possibly dynamic targets) for some sectors and assistance provided to reduce greenhouse gas emissions	Not applicable

We assume here three country groups. Group A would consist of current Annex I countries and those countries whose per capita emission levels are initially above 9 tCO₂-eq/capita, around 2/3 of current Annex I average. The threshold is decreasing to 4.4 tCO₂-eq/capita for participation in 2050. This group would receive absolute emission reduction targets, shared according to sectoral considerations. Group B would be a new group that aims at stabilization of per capita emissions. Countries with per capita emissions between 5 and 9 tCO₂-eq/capita, 1/3 to 2/3 of current Annex I average, would be in this group. The cut-off level of 5 tCO₂-eq/capita declines to 2 tCO₂-eq/capita in 2050. These countries would receive flexible targets of sectoral targets. Groups C would include the countries with emissions below 5 tCO₂-eq/capita and all the countries with a GDP per capita below US\$ 4000. These countries would be assisted in limiting their emissions. A graphical summary along with shares of the world's greenhouse gas emissions is presented in Figure 22.

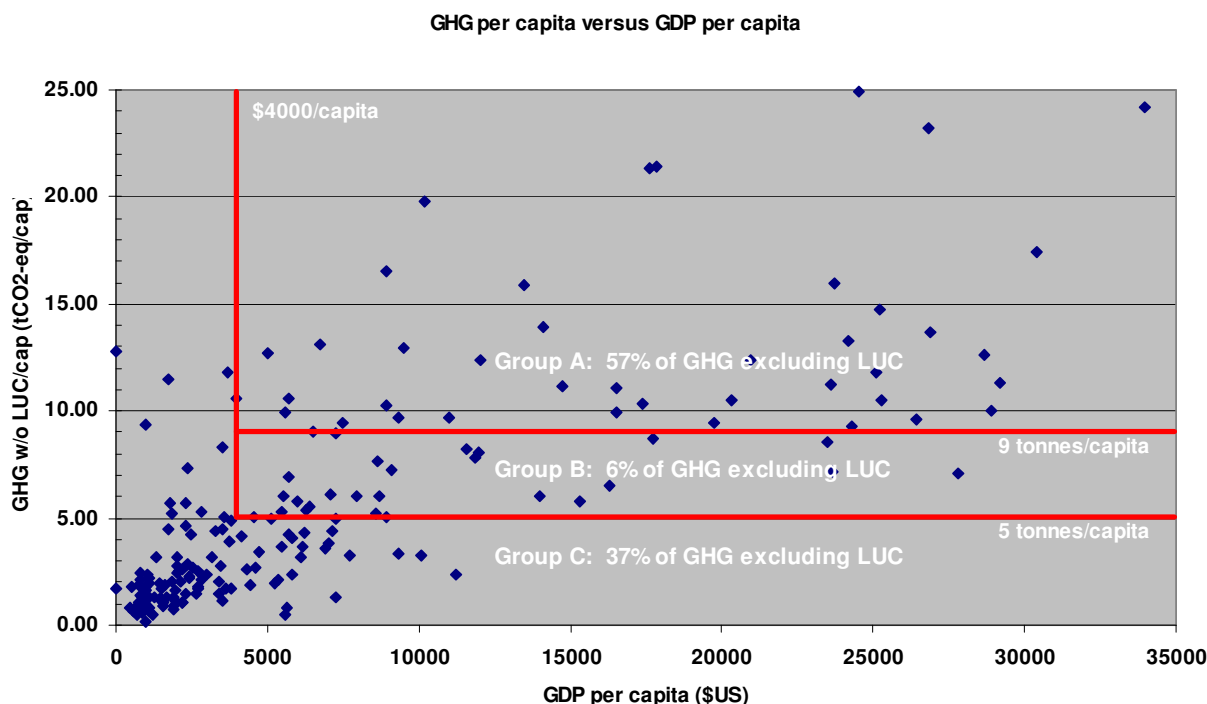


Figure 22: Country groupings in the multi-stage approach and corresponding shares of greenhouse gas emission reductions (group percentages are slightly adjusted to accommodate all Annex I countries into Group A) (CAIT v1.5, 2000)

It should be noted that the group percentages in Figure 22 are slightly adjusted for Annex I countries that are situated outside of Group A due to low greenhouse gas per capita emissions, including France, Portugal, Slovakia, Hungary, Sweden, Switzerland, Croatia, Romania, Lithuania, and Latvia. These countries would still assume absolute emission reduction targets.

The first two categories of Table 12 – *Criterion* and *Ambition level of commitments* – would be key to initially obtain agreement upon. Consensus here could help establish a base to build upon and facilitate further agreements on the more contentious categories of types and differentiations of targets.

For the illustrative parameters given in Table 12, we have calculated emission allowances for various countries. The results are presented in Figure 23 and Table 13.

We assumed that the USA reaches its national target of 18% intensity improvement by 2010, which we assumed to be 23% above absolute 1990 levels. All other Annex I countries reach the lower of their Kyoto targets and their reference scenario in 2010. All reference emissions are based on the IPCC SRES A1B scenario. For details of the model used see Höhne et al. (2005).

We assumed the average Group A on average countries reduce emissions 30% below 1990 levels in 2020, which is a decline from 2010 to 2020 of 3% per year as a group. The groups A continues to reduce at that pace after 2020.

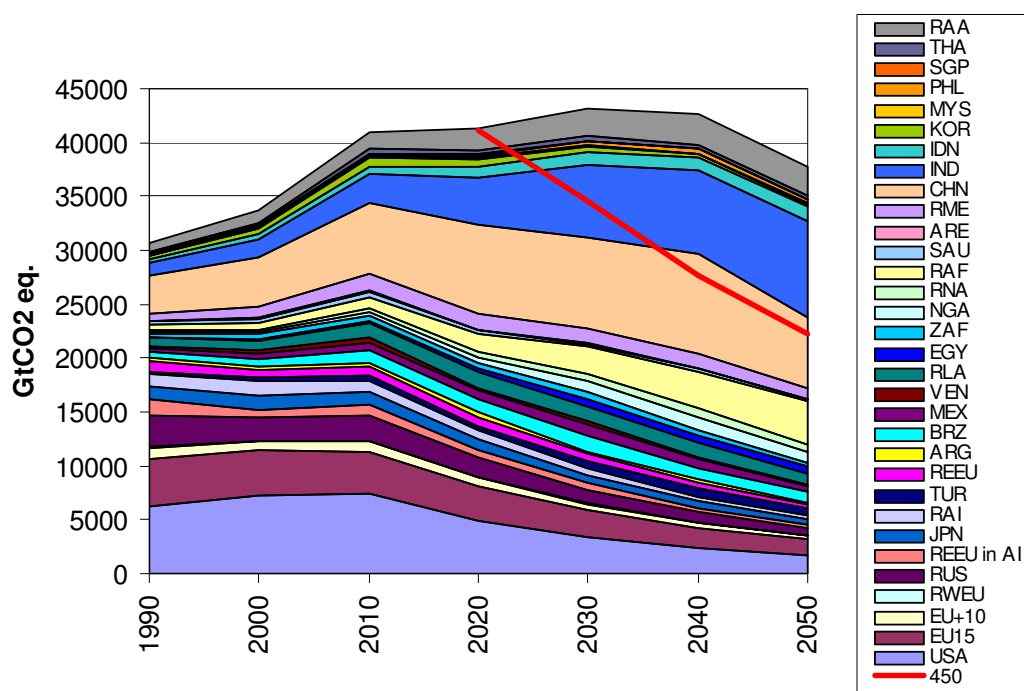


Figure 23: Emission allowances under the Multistage approach for the A1B scenario with the given parameters. Red line as of 2020 shows the global emission path that would be necessary to reach 450 ppmv CO₂ concentration

Table 13 shows the possible entry date for selected countries and regions. Countries that newly enter Group A for 2020 include Argentina, Bahrain, Brunei, Cyprus, Gabon, Israel, Jamaica, Kazakhstan, Korea (South), Kuwait, Libya, Oman, Paraguay, Qatar, Saudi Arabia, Singapore, Taiwan, Trinidad & Tobago, Turkmenistan, United Arab Emirates, Uruguay and Venezuela. Countries that enter Group B for 2020 include Algeria, Bosnia & Herzegovina, Brazil, Chile, FYR Macedonia, Iran, Jordan, Lebanon, Malaysia, Malta, Mexico, Panama, Serbia & Montenegro, South Africa, Thailand and Turkey.

We observe from Figure 23 that with the given parameters the global emission level in 2020 is about 35% above 1990 levels, which would allow keeping the option of stabilizing CO₂ concentrations at 450 ppmv open. However, global emissions have to decline after 2020 to roughly 20% below 1990 levels to keep the 450 ppmv option open (thick line in Figure 23). This is not the case for the given parameters. More ambitious reductions or lower participation thresholds would need to be implemented.

In conclusions, the parameters given in Table 12 are in line to keep the option of stabilizing CO₂ concentration at 450 ppmv open in 2020 if followed by global reductions afterwards. But more stringent measures are required after 2020 to keep 450 ppmv within reach.

Table 13: Likely date of entry into the different stages aiming at 450 ppmv in the long term.

Based on data in ...	2010	2020	2030	2040
Member of group in...	2020	2030	2040	2050
USA	A	A	A	A
EU15	A	A	A	A
New EU Members	A	A	A	A
Rest of Western Europe	A	A	A	A
Russia	A	A	A	A
Rest of EEU in AI	A	A	A	A
Japan	A	A	A	A
Rest of Annex I	A	A	A	A
TUR*	B	B	B	A
Rest of Eastern Europe*	C	B	A	A
Argentina*	A	A	A	A
Brazil	B	B	A	A
Mexico	B	B	A	A
Venezuela*	A	A	A	A
Rest of Latin America*	C	B	B	A
Egypt	C	C	B	A
South Africa	B	B	A	A
Nigeria	C	C	C	B
Rest of North Africa*	B	B	B	A
Rest of Africa*	C	C	C	C
Saudi Arabia	A	A	A	A
United Arab Emirates	A	A	A	A
Rest of Middle East*	C	B	B	A
China	C	B	B	A
India	C	C	B	B
Indonesia*	C	C	B	B
South Korea	A	A	A	A
Malaysia*	B	A	A	A
Philippines*	C	C	C	B
Singapore	A	A	A	A
Thailand*	B	B	A	A
Rest of Asia*	C	C	C	C

"Stage 4" denotes the state, where a country has reached a very low per capita emission level and does not reduce emissions further.

*: The date of the countries' participation may be affected by the method used to determine future values. We have downscaled regional growth to country level. This may lead to some biased outcomes, notably for the highlighted countries.

III. Agreements on adaptation

i. Important elements

Adaptation to climate change is one of the key issues of concern for many developing countries, who perceive that although much is being done in the way of mitigation for addressing the climate change issue, adaptation has taken a back seat. Indeed, mitigation efforts are already underway in both Annex I and non-Annex I countries and mitigation still dominates the climate change process. Adaptation issues have advanced much less rapidly and the urgency to achieve progress in this area was re-emphasised in the Delhi Ministerial Declaration resulting from COP8. Recent developments in the Buenos Aires programme of work on adaptation and response measures have reiterated the importance of adaptation. Currently pilot and demonstration projects are being carried out as are activities to strengthen adaptive capacity. A formal request was made for the Global Environmental Facility (GEF) to report on activities under the themes of vulnerability, adaptation and modes of funding. This will take place at COP11.

Discussions to address mitigation efforts on the part of developing countries are likely to be more fruitful if developed countries can already clearly demonstrate a commitment to addressing adaptation. Adaptation must therefore form part of the final negotiation package.

To obtain agreement on adaptation, it is important to first be clear on what is meant by adaptation in the climate change context and its corresponding scope. The Third Assessment Report (TAR) of the IPCC defines adaptation as "adjustments in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects or impacts" (Burton et al. 2001). This definition still leaves room for interpretation. In principle, three types of adaptation activities could be envisaged:

1. Measures could be **forward-thinking in avoiding expected damage** or to prevent damages that have occurred for the first time in the past. Building dikes against sea level rise or changing agricultural practice to keep production on a sufficient level under drier circumstance would be such proactive measures.
2. Measures could also be taken to **ensure damage repair, restoration or compensation**. Insurance could compensate for the damage that will occur, if no adaptation measures are taken or if adaptation measures are insufficient to avoid damage. Such insurance could be seen as a form of adaptation. If the risks increase, the coverage of the insurance is extended.
3. In addition, measures could be taken to **strengthening the general capacity of communities to adapt** to unexpected or future changes in climate. A country with higher economic development can better adapt to changes in climatic conditions than countries with a lower economic development. Such measures can be interpreted as covering a very broad set of issues, basically covering poverty alleviation and economic development. In such case, only the climate change specific adaptation activities should be considered under the UNFCCC.

The IPCC's Third Assessment Report also highlights a number of impact themes such as hydrology and water resources, ecosystems and their goods and services (food supply), coastal zones and marine ecosystems, human settlements, energy and industry, insurance and other financial services, and human health.

In conjunction with these risks, it is important to understand the vulnerability faced by individual countries. Vulnerability refers not only the expected negative impacts of climate change and response measures, but also to the capability to respond and cope with such negative effects. It can therefore be used as a measure of each country's own ability to adapt and, by extension, a measure of their further adaptation needs.

It is possible to develop a methodology to group countries according to their vulnerability in terms of expected impacts and adaptive capacity. An example of such an approach is shown in the diagram below (Downing 2002) where developing countries are classified into 4 groups (Figure 24) using data on potential damages and the human development index. In the approach by Downing, the value (\$) of potential damages is estimated by applying econometric techniques to a change in an impact model (e.g. biophysical impact model such as water balance) linked to a given climate change scenario. In this case, the potential damages are related to food security, thus taking into account only agriculture,

water and sea-level rise impacts. The human development index is the indicator used for relative adaptive capacity.

		Adaptive capacity	
		Low	High
Impacts	High	Vulnerable Communities: Most vulnerable areas with the highest need for adaptation	Development Opportunities: Assistance would be directed towards strategy for coping with increased risks.
	Low	Residual risks: Potentially vulnerable if impacts are greater than expected.	Sustainability: Little or no assistance required

Figure 24: Methodology for categorisation of developing countries according to vulnerability (Downing 2002)

With such a system of categorisation, different areas of priority for addressing adaptation issues can be identified for different categories of countries. Developing Countries with high expected impacts and low adaptive capacity (vulnerable communities) would thus be given high priority for adaptation measures. Where impacts are potentially high but adaptive capacity is also high (development opportunities), assistance could be directed towards realising a sustainable strategy to cope with increased risks. Where impacts are low (top row in diagram) further information on the nature of climate change could be required, but a precautionary approach may be needed for situations of low adaptive capacity to be prepared for possible surprises (residual risks). In the case of low expected impact and high adaptive capacity (sustainability) little or no external assistance would be expected for achieving sustainable livelihoods.

With the above methodology some results would be for example: China, India and Brazil are classed as residual risk communities (low impact, low adaptive capacity) and Mexico is classed as vulnerable communities (high impact, low adaptive capacity). Figure 25 provides a map colour-coding the countries according to their categories. Note that for the purposes of the adaptation discussion, countries categorised as 'vulnerable communities' and 'residual risks' are the most relevant (refer to the diagram 'Key' below).

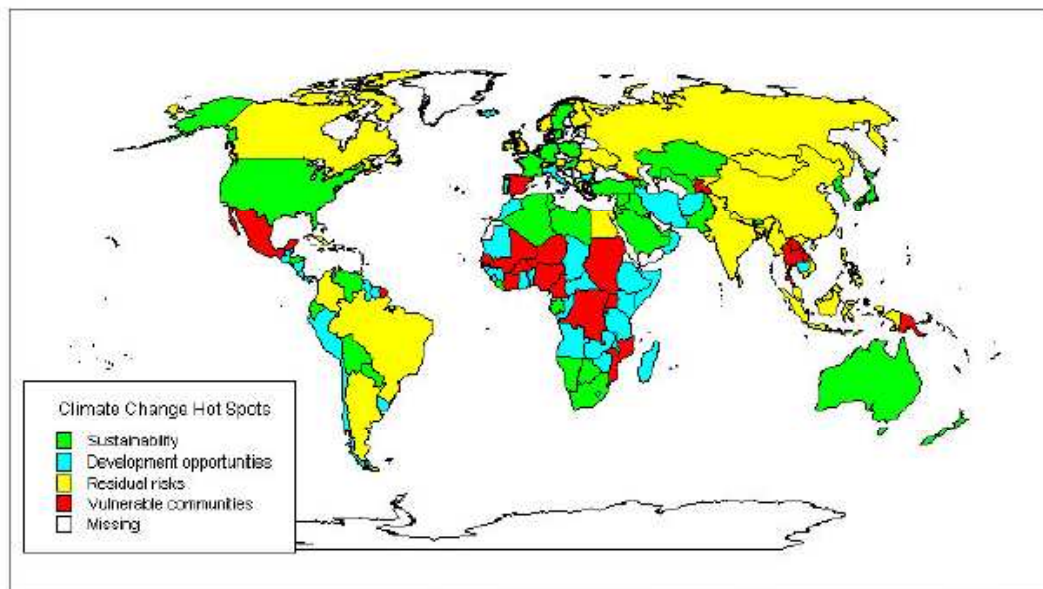


Figure 25: Clusters of climate risk (Downing 2002) where Sustainability indicates low impact, high adaptive capacity; Development opportunities refers to high impact, high adaptive capacity. Residual risks indicates low impact, low adaptive capacity and finally Vulnerable communities with high impact, high adaptive capacity.

Vulnerable countries will need to address climate change by improving water supply systems and use water in a more efficient way, improve agriculture and adapt to changed climatic conditions, provide for coastal defence, organise damage control from storms and floods, and improve healthcare. These issues are typically incorporated into official development assistance (ODA) support measures, which leads to important financing questions: is funding provided outside of ODA assistance, separate to ODA, or a combination of separate funding in conjunction with ODA.

We will first discuss costs associated with adaptation, and then correspondingly propose possible elements that can lead towards an agreement on adaptation.

ii. Costs of adaptation

Not much is known about the costs of adaptation. The scientific literature has mainly focused on the damage costs in the long run – with the main focus of the damage under business-as-usual developments. Costs of adaptation will most likely be lower or much lower than the damage costs. What is especially relevant are the adaptation costs in the coming decades:

- Most estimates of damage costs for greenhouse gas emissions are in the range \$5-20 per tonne of carbon, but the level of uncertainty remains high. Damage costs can be as high as several hundreds of billions Euro per year in 2100. (Tol et al, 2001)
- It is estimated that in 2020 the decrease in global cereal production will be 35 million metric tonnes (increasing to 165 million metric tonnes in 2080 under the so-called HadCM3 experiment) (Parry, 1999). At average cereal prices of 200 US\$/tonne the 2020 decrease represents 7 billion US\$.
- Economic loss through weather-related catastrophic events has risen from 4 billion US\$ in the 1950s to 40 billion US\$ in the 1990s (Vellinga and Mills, 2001). Climate change will further increase the occurrence of catastrophic events, and so will economic loss.
- Improving coastal defence for the Netherlands only will cost 1 – 2 billion Euro per year for the coming two decades partly these costs can be attributed to climate change (Vellinga and Mills, 2001). Adaptation costs for coastal defence worldwide will be considerably higher.

These figures are very indicative, but they suggest that it might well be that the costs of adaptation will end up somewhere in the range of 10 – 100 billions of dollars. It should be stressed that adaptation costs are highly uncertain and further analysis is necessary in this area. Regardless, a substantial part of the costs will fall in developing countries, with limited ability to pay.

As mentioned before, many of the adaptation action is closely connected to certain action already defined in the framework of ODA. This makes a comparison to current ODA levels useful. The official development assistance in 2002 was about 70 billion US\$ (this was 0.23% of GDP of the donor nations, which can be compared to the target contribution of 0.7% of GDP) (OECD, 2003). Hence adaptation costs may be of same magnitude.

iii. Existing Funds

Three separate funds have already been established that consider adaptation to climate change. These include:

- **Special Climate Change Fund (SCCF):** established (under Decision 7/CP.7) to support climate change activities in the areas of: "adaptation (5/CP.7 para. 8); technology transfer (4/CP.7); energy, transport, industry, agriculture, forestry and waste management; and activities to assist developing countries...in diversifying their economies". The SCCF is administered under the UNFCCC under guidance from the GEF and the Subsidiary Body for Implementation (SBI). During COP10, a total of 34.7 million US dollars was pledged to the fund and the SBI will present further guidance during COP11.
- **Least Developed Country (LDC) fund:** established (under Decision 7/CP.7) to support, inter alia, preparation and implementation of national adaptation programmes of action (NAPAs). The fund is to support a work programme for LDCs, which includes, amongst others, support in development, preparation and implementation of NAPAs to communicate vulnerabilities and adaptation needs, and the development & transfer of technology (especially adaptation technology).

National action plans for adaptation (NAPAs) were established to serve as a 'simplified and direct channel of communication of information relating to vulnerability and adaptation needs of least developed countries', and may act as a first step in the preparation of National Communications to the UNFCCC (5/CP.7, II.15). The NAPA identifies urgent and immediate adaptation needs of LDCs for adapting to the adverse impacts of climate change, and sets out a list of priority activities¹¹, as identified by the LDCs themselves (according to justification criteria). The implementation of priority activities is intended to be financed by the LDC fund and other funds.

Guidelines have already been established for NAPA preparation (Decision 28/CP.7), and some NAPAs are already being prepared with the help of GEF funding. As of October 27, 2003, funding for the preparation of NAPAs was approved for 26 countries and 1 additional project was at an advanced stage of preparation (GEF 2003). Progress to date has been slow, and during COP10, GEF was requested to assist in expedited the process NAPA preparation. Further discussion will take place at COP11.

The LDC fund is a fund under the UNFCCC. Contributions are voluntary. It is currently the only developing country climate change fund that is operational, however large doubts exist as to its sufficiency. As of October 27, 2003, total contributions received amounted to US\$ 9.7 million, with outstanding pledges in the further amount of \$ 6.4 million US (GEF 2003). As of the same date, projects totalling \$ 6 million US for the preparation of NAPAs were approved. Additional contributions have been made during COP11, the GEF will report further on efforts to finance the NAPAs.

- **Adaptation fund:** is a Kyoto Protocol fund (Art. 12.8 of KP). The adaptation fund (established under 10/CP.7) is to support "concrete adaptation projects and programmes" in DC Parties. It will be financed from the "share of the proceeds" on the clean development mechanism and other sources of funding. It is to be used to "assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation". The total envelope of funds depends on the level of CDM activity (which depends on the chosen method of implementation of each developed country). The fund is not yet operational, although a high level for funding has been pledged by various countries.

¹¹ Activities are 'those whose further delay could increase vulnerability, or lead to increased costs at a later stage', and should include, inter alia projects, integration into other activities, capacity building, policy reform.

Den Elzen and Moor (2001) estimate a maximum gain from CDM of 3000 million US\$(1990) over the first commitment period without participation of the USA. Two per cent of proceeds (i.e. maximum 60 million US\$) are directed to the adaptation fund.

iv. Possible elements for an agreement on adaptation

Despite the uncertainty, it is likely that yearly costs required to address adaptation issues will be considerable, at least in the tens of billions of US dollars. Reaching agreement on adaptation could be done under existing negotiations or under a separate legal instrument.

The idea of a separate legal instrument under the Convention could provide the assurances and security required by both developed and developing countries to come to an agreement on adaptation (Müller 2003). At COP8, the Indian delegation put forward the idea to include the adoption of a 'Protocol on adaptation' as part of the action for initiating further action for assessment of adverse effects, and steps to facilitate implementation of adaptation measures. Such a legal instrument could provide the dual guarantees needed for agreement: on the one hand developing countries want a commitment to sharing of the burden of climate impacts and assurance that they have recourse to compensation, and on the other hand donor countries will want to ensure that there are boundaries to funding for compensation (Müller 2003).

Adaptation levy

Applying the principle 'the-polluter-pays' could lead to a levy on greenhouse gas emissions and use this to pay for the costs of adaptation. A relatively small levy of \$0.5 - \$1.0 per tonne of CO₂-eq. on all current global greenhouse gas emissions¹² would raise a fund of approximately 20 to 40 billion dollars per year, which would be a substantial starter to an adaptation fund. Starting contributions with perhaps a \$0.1 - \$0.25 per tonne of CO₂-eq. level would be useful and build to a goal of \$1.0 per tonne of CO₂-eq.

A levy could be applied differently to the Groups A, B and C defined in the multi-stage section above. Group B's contribution could be half the rate paid by Annex I countries, perhaps the final goal being a \$0.50 per tonne CO₂-eq. on their global greenhouse gas emissions.

According to Ecofys' Carbon Price Calculator (a tool which estimates the impact costs per tonne of CO₂-eq. have on fuel and electricity prices), the contribution of €1 per tonne of CO₂-eq. emitted in the Netherlands, for instance, would have a minor effect on end consumer costs. As is presented in Table 14, changes to electricity costs would be between 1-2%, depending on fuel source. Note however that in an international protocol, countries would be assigned a levy. Countries can choose to pay the charge from national budgets or to defer it to the emitters of greenhouse gases or final users of energy.

Table 14: Fuel and electricity price increases due to a €1 per tonne of CO₂-eq.

Price increase for:	Net Increase	% Increase	Customer Type
natural gas	€0.002/ m ³ gas	2%	Large
natural gas	€0.002/ m ³ gas	1%	Households
gasoline	€0.002/L	0.2%	n/a
crude oil	€0.46/barrel	2%	n/a
steam coal	€2.7/tonne coal	7%	n/a
electricity from new combined cycle	€0.0004/kWh	1%	Large
electricity from mix coal/natural gas	€0.0006/kWh	1%	Large
electricity from coal	€0.0009/kWh	2%	Large
electricity from new combined cycle	€0.0004/kWh	0%	Households

¹² For industrialized countries the ratio between historic and current responsibility is about a factor 1.4 higher than for developing countries (Höhne and Blok, 2004). This could be incorporated in the magnitude of the levy. However, it seems reasonable that also developing countries in one way or the other contribute to an adaptation fund. This need not necessarily be out-of-pocket, but it could also be in the form of an own contribution to the domestic adaptation cost.

electricity from mix coal/natural gas	€0.0006/kWh	1%	Households
electricity from coal	€0.0009/kWh	1%	Households

Generated revenue could be focussed on first implementing projects identified in the NAPAs mentioned earlier. Current funding has been approved for 26 countries for the preparation of NAPAs. As such it may be expected that completed NAPAs may be available for 2005 (as of writing only Mauritania's was available) and seeking implementation. There is not yet dedicated funding for NAPA *implementation*. The concern over adequacy in funding in general, has been raised several times by Developing Countries, and the issue of financing NAPA implementation is no different. Submissions from Least Developed Countries on views on strategies for NAPA implementations clearly state concern over adequacy of funding for adaptation particularly in view of financial commitments to-date of Annex I countries. Given that: 1. the LDC fund is already viewed as insufficient 2. the SSCF and Adaptation fund are not yet operational, and 3. there is no commitment on the extent of resources to be allocated for adaptation activities from the GEF Trust Fund, LDCs are looking for a clear commitment on the level of resources to be dedicated to adaptation (FCCC/SBI/2003/MISC.4).

One way to positively address the adaptation issue is by demonstrating a willingness to support adaptation with concrete funding and a first step could be through a commitment to support NAPA implementation, for example by creating a start-up fund for financing implementation of the first NAPA projects (whether via the LDC fund or one of the other or new funding mechanisms). This could help to initiate a funding process, for more widespread, continuous NAPA implementation as the number of NAPA activities increases.

Insurance

Since the attribution of blame or liability for current climate change effects is placed with the historically big greenhouse gas emitters (the main target amongst these being the developed countries, seen to benefit the most from their emissions), these countries are expected to provide compensation for helping developing countries to deal with the negative effects and impacts. Art. 4.8 of the Convention refers to insurance as a means to minimise adverse effects of climate change and/or the impacts of response measures on developing countries (DCs). If a way could be found to establish a system of insurance at the international or global level to compensate for the adverse effects of climate change (for e.g. insurance against natural disasters) then it would provide a vehicle for structured funding of adaptation measures by developed countries after damage has occurred, and demonstrate to DCs a commitment to addressing their adaptation concerns.

Two approaches to establishing an international insurance scheme are described below ((A. Michaelowa 2003), (Mace 2003), (UNEP 1993)).

Insurance based on contributions from emitters (non-risk community): Taking as an example the increase in number and severity of natural disasters in DCs – on the principle that greenhouse gas emitters are liable for climate-related disasters in developing countries, a system of insurance could be envisaged where the emitters pay the premium of developing country losses from climate change (see also Müller 2003). This could be accompanied by a small share of loss-bearing on the part of the insured developing countries so as to avoid moral hazard¹³.

This concept was taken further in a proposal put forward by AOSIS in 1991. The proposal sets forth the idea of an "international insurance pool" to cover loss risks experienced by DCs as a result of climate change impacts (in AOSIS case, losses related to sea-level rise), and to distribute the financial burden amongst developed countries. Under the proposal, the insurance pool would be funded via mandatory contributions from developed countries, based on their level of CO₂ emissions and their GDP (50/50 weighting). The loss-sharing approach in the AOSIS proposal is similar to that used in the OECD Nuclear Damage Convention (1963) and Oil Pollution Damage Convention (1971). Even though the AOSIS proposal addresses the concerns of its members about sea-level rise, the same concept could be applied to other groups of countries and other climate change damages.

¹³ Moral hazard is the risk that coverage against a loss might increase the risk-taking behaviour of the insured party, or prevent the insured from taking precautionary or loss-prevention measures themselves.

Insurance based on contributions from affected countries (at-risk community): This type of insurance comprises, as a first basis, contributions from the at-risk community (persons, enterprises, governments at risk) e.g. via commercial, public insurance. International bodies, or governments can support or subsidise this type of system for e.g. by providing forms of reinsurance for cases where the original insurance pool is exhausted. In such a case this option becomes very similar to the first option.

Regardless of the architecture of an international insurance system, more work still needs to be done with respect to determining the actual valuation of damages to be included in the scheme, and ultimately the level of funding required from developed countries.

Given the past discussion, it seems unlikely that a discussion on insurance of climate change damages can be held in isolation from insurance for adverse effects of "response measures". Either both issues have to be de-coupled or progress has to be made on both areas. In addition, it seems likely that any system of insurance can be initiated by the UNFCCC but would then be transferred to a different international regime, such as that on e.g. disaster relief.

v. Further steps

And finally, despite the volume of investigations, much effort still needs to take place with respect to adaptation. These themes include:

Streamlining of work: The current treatment of adaptation in the negotiation process is fragmented. The notion of one agenda item to consider the issue could be supported.

Adaptation needs and cost: Despite the body of work that has already been done in respect of the adaptation issue – risk identification, geographic distribution, ability to cope (vulnerability) – it is clear that not enough is known about the level of adaptation needs, in terms of quantified costs of adaptation for developing countries. Further studies are still required to determine what adaptation activities are required, where, with what urgency, and ultimately at what financial cost.

The costs of implementation of the NAPAs can provide a useful reference for the costs of certain adaptation activities – in particular those aimed at preventing or reducing potential future damages and associated future costs. An update on NAPA preparation will be presented at COP11 and the Subsidiary Body for Scientific and Technical Advice will also present further recommendations concerning the scientific, technical, and socio-economic aspects and impacts of, and vulnerability and adaptation to, climate change.

On a more long-term basis further work will need to be done into estimation of costs associated with damage repair and the magnitudes of funding required to effectively address these, such as within an international insurance system.

IV. Agreements on land-use change and forestry emissions

i. Introduction

Greenhouse gas emissions and removals from land use, land-use change and forestry (LULUCF) activities have significantly different character than greenhouse gas emissions from fossil fuels, for several reasons:

- *Non-permanence or reversibility:* Forestry activities can also remove CO₂ from the atmosphere. This removal can be reversed and result in an emission of the equal amount of CO₂, e.g. when the accumulated biomass is burnt or decays.
- *Uncertainty:* Estimation of LULUCF emissions and removals is more uncertain than for fossil fuel emissions. While CO₂ emissions from fossil fuels can be estimated relatively accurately from the quantity of fossil fuels used, the emissions and removals from land use, land use change and forestry activities are dependent on many mostly biological variables. The certainty of the emissions is in the same order of magnitude as emissions of CH₄ and N₂O from biological processes (e.g. rice production, fertilization). Within the bands of uncertainty, the anthropogenic global CO₂ emissions from forestry today may be 1/6 to 1/3 of fossil fuels emissions.
- *Small anthropogenic changes to a large natural turnover and stock:* The anthropogenic part of forestry emissions and removals is very small compared to the natural turnover of CO₂ in the atmosphere, making it difficult in some cases to separate the human induced part from the natural part. The terrestrial biosphere stores in vegetation and soil organic matter contain about three to five times as much carbon (C) as the atmosphere (Sabine et al., 2004; Schlesinger 1997). Small changes in biospheric carbon stocks can therefore significantly alter the atmospheric CO₂ concentration. The variability of the annual fluxes is also high as it is driven by natural variation in regional weather patterns linked to natural rhythms of the climate system and natural variation of radiation.
- *Impact on global carbon cycle:* The total terrestrial biosphere is currently acting as sink, while the anthropogenic activities in the biosphere are a source of emissions (mainly deforestation). The natural terrestrial biospheric uptake is expected to decline due to factors such as climate change and saturation effects. It currently removes a substantial part of all CO₂ emissions (also from fossil fuels) from the atmosphere. There is a risk of the natural biospheric sink turning into a source in the course of this century, affecting the removal processes of CO₂ emissions.
- *Delay between action and emission/removal:* Forestry emissions and removals may still occur many years after the human intervention, while emissions from fossil fuels are immediate when the fuel is burnt. E.g. sequestration through afforestation occurs many years after the trees are planted. An activity started in, e.g., 1993 may still be sequestering CO₂ in 2010. Whilst terrestrial ecosystems lose carbon quickly by disturbance such as harvest or fire, carbon uptake occurs at slower rates.

Biospheric carbon sinks and sources were treated differently from the other sectors in the Kyoto Protocol. The controversies and the delay in the detailed implementation of rules and modalities for land use, land use change and forestry (LULUCF), after setting the original Kyoto targets, led to a complicated accounting system with gaps and asymmetric incentives to account for sinks rather than for sources (Schulze et al. 2002, Höhne et al. 2004).

The Kyoto Protocol established a regime that implements a single target for a basket of greenhouse gases (CO₂, CH₄, N₂O, HFCs, PFCs, SF₆) that can be met through efforts and activities in all sectors included in the emission reporting which are energy, industrial processes, agriculture, waste and to a limited extent from land-use, land-use change and forestry. Neither were targets set for individual gases, nor for individual sectors or activities. Emissions and removals from selected LULUCF activities (afforestation, deforestation, reforestation, forest management, revegetation, crop land management and grazing land management) are included (or can voluntarily be included) in the basket of gases and sectors that can be used to achieve the Kyoto target. Different rules apply to the different activities.

The following section of this report elaborates on the options that for integrating activities related to land use, land-use change and forestry in a future climate agreement, drawing upon recent literature (Schlamadinger et al. forthcoming, Herold et al. forthcoming, Freibauer et al. forthcoming).

ii. Options

Several general options exist how to integrate activities related to land use, land-use change and forestry in a future climate agreement:

1. Selected LULUCF activities in the Kyoto basket (continuation of the existing approach)
2. All emissions and removals on managed lands in the Kyoto basket
3. Separate quantitative emission targets for LULUCF activities
4. Separate protocol for LULUCF activities

This section is largely based on Herold et al. (forthcoming). The options are summarized in Table 15.

Option 1: Selected LULUCF activities in the Kyoto basket (continuation of the existing approach)

The first option would be to continue the existing approach under the Kyoto Protocol, where emissions and removals from selected activities are included (or can voluntarily be included) in the basket of gases and sectors

The option offers countries flexibility in the way how the general target will be achieved and in the contributions of individual sectors and individual gases to the overall effort which can be decided nationally after the general agreement of the overall target. The efforts required in each sector remain a national decision on the basis of national circumstances and priorities. The option allows a trade-off between sectors and gases, in particular between the reduction of emissions and the enhancement of carbon sinks. The advantage is that such a type of target offers flexibility in the implementation for those Parties willing to contribute with quantitative targets. This flexibility can move countries to take on more stringent overall targets.

The selection of the activities keeps the emissions and removals from this sector confined and manageable.

Several arguments are also voiced against this approach:

- The current system has relatively complicated accounting rules. These could be simplified in some areas in a second commitment period.
- Non-permanence: only contiguous commitment periods can ensure that once accounted removals are counted as emissions, if reversed
- Natural inter-annual variability may be greater than the reduction effort levels. An average over the commitment period or longer help to overcome this problem.
- LULUCF may provide low cost reduction options in the short term and may therefore distract from reducing fossil fuel emissions in the short term. When in the long term the sink mechanisms of the biosphere is no longer available, the technologies reducing fossil fuel emission may not available.
- A general quantitative target may not yet be applicable to Non-Annex I Parties, because the main emitters such as China, India and Brazil strongly oppose quantitative targets and targets comparable to those of Annex I Parties under the Kyoto Protocol.

From the experiences with the Kyoto Protocol, it would be beneficial if a future agreement will clearly specify all gases, sectors and sectoral activities included in a general cross-sectoral and cross-gas

target and that such activities will not be negotiated in a second step after the setting of the general target as it occurred for Article 3.4 activities for the first commitment period. The coverage of the target should be clear before it is finally agreed.

Option 2: All emissions and removals on managed lands in the Kyoto basket

As another option, one could include all emissions and removals from all managed lands in the Kyoto basket ("full carbon accounting"). This would simplify the accounting approach compared to the one used under the Kyoto Protocol. Under such an approach also the enhanced indirect human induced removal due to CO₂ fertilisation, nitrogen deposition and the changing climate would be accounted, but could be taken into account when setting the overall target.

The accounting for all carbon flows from the biosphere is in principle less complex than the current rules under the Kyoto Protocol, but still challenging for most countries.

All other arguments given for option 1 would equally apply to this option.

Option 3: Separate quantitative emission targets for LULUCF activities

Alternatively, separate quantitative targets could be set for LULUCF activities, which cannot be traded with quantitative targets for other emissions. A separate quantitative LULUCF target would be established in a similar way as targets for other sectors, but compliance would be assessed separately.

The motivation for this approach is that emissions from fossil fuel combustion *and* deforestation have to be reduced simultaneously to limit the global mean temperature increase to below 2°C, a trade off between the two is to be avoided. The risk of large scale releases of carbon from the biosphere arising from climate change, including the risk of climate change induced collapse of the Amazon forests, is an additional concern in this area (see also Greenpeace 2003).

A separate quantitative emission target for the LULUCF sector could take several forms:

- A target for annual emissions/removals from the LUCF sector (as for emissions from fossil fuel combustion)
- A target for the conservation of carbon stocks (not emissions/removals)
- Simplified targets for specific land use classes. For example, temporary carbon changes within the same classes remain unaccounted whereas land units that move from one class to another are accounted over a transition period (Schlamadinger et al. forthcoming).

This option would reduce flexibility for Parties in the achievement of future commitment rules to some extent, as the main quantitative target would no longer include emissions or removals from LULUCF. A separate LULUCF target would mean that a national, concrete and inflexible target for LULUCF emissions and removals would be established for each participating country. At the national level, it may be easier to agree to a basket target covering all sectors as the allocation to sectors can be resolved during the years of implementation.

A separate quantitative LULUCF target could also be unacceptable for certain Non-Annex I Parties where considerable emissions occur from deforestation. This could decrease the likelihood to integrate major emitters from Non-Annex I Parties.

Option 4: Separate protocol for LULUCF activities

A further option is a separate protocol for LULUCF activities. This protocol could include activities in the LULUCF sector, such as a commitment to the reduction of the deforestation rate or financial contributions for the conservation of forests. Another example would be the trade of non-utilization rights of rainforests.

Such an approach would achieve a full separation of the problem of reducing emissions from fossil fuel combustion and from LULUCF activities. It would allow to use the types of commitments that are best suited for the LULUCF activities.

Such alternative target types for LULUCF would offer advantages in reduction of complexity of the accounting system under the Kyoto Protocol or addressing key difficulties in a simple and straightforward way. The uncertainty about the emissions from LULUCF is less relevant.

The separation into two separate protocols could increase negotiation time and efforts, but possibly not the likelihood to negotiate ambitious reduction or stabilisation targets. There would also be the risk that only one part of the negotiation would be successful with the effect that the other part would remain unaddressed.

A separate Protocol would require agreement on its own rules and instruments for monitoring, control and verification of targets and non-compliance procedures. The bureaucratic and institutional efforts and costs needed might be considerably higher than for the current basket approach and negotiations would start from scratch without building on existing experiences.

Parties cannot be forced to ratify both protocols, this means a trade-off between LULUCF sector and other sectors would still be possible by ratifying only one of the Protocol, e.g. in case of increasing sinks and high carbon stocks of the LULUCF protocol, but high emissions from fossil fuels, only the LULUCF protocol could be ratified. It is unlikely that those countries with high emissions from deforestation and with high losses of pristine forests will ever ratify a separate LULUCF protocol. The ratification of one of the protocols reduces public pressure from environmental NGOs on governments as some efforts at international level can be shown.

A number of efforts that tried to set international targets at sectoral level (e.g. target for renewable energy in Johannesburg summit, protocol under UN forest process) have not been successful. The effect that an agreement on climate change could also provide incentives to solve the issue of deforestation would be lost with a separate protocol.

iii. Summary and Conclusions

The preceding discussion is summarized in Table 15. We see that each of the four options has its particular advantages and disadvantages.

Table 15. Overview of options for including LULUCF in an international climate agreement

Description of approach	Arguments made in favour of the approach	Arguments made against the approach
1. Selected activities in the Kyoto basket	• High flexibility for countries to reduce emissions between sectors and gases • Could move countries to agree to more stringent targets • Selection of activities keeps amount of removals/emissions manageable	• Complicated accounting rules • Only contiguous commitment periods ensure once accounted removals are counted as emissions if reversed • High natural inter-annual variability can water down reduction efforts • Low cost LULUCF reduction options may distract from reducing fossil fuel emissions • Fixed quantitative targets possibly not acceptable for Non-Annex I countries
2. All emissions and removals on managed lands in the Kyoto basket	• Maximum flexibility for countries to reduce emissions between sectors and gases • Could move countries to agree to more stringent targets • Simplified, but still ambitious accounting rules compared to option 1	• Need careful consideration of indirect removals due to e.g. CO₂ fertilisation • Only contiguous commitment periods ensure once accounted removals are counted as emissions if reversed • High natural inter-annual variability can water down reduction efforts • Low cost LULUCF reduction options may distract from reducing fossil fuel emissions • Fixed quantitative targets possibly not acceptable for some Non-Annex I countries
3. Separate emission target	• Emphasis that emissions from deforestation <i>and</i> fossil fuels have to be reduced	• Less flexibility in reducing emissions across sectors • Process of target setting more complicated • Fixed quantitative targets possibly not acceptable for some Non-Annex I countries
4. Separate Protocol for LULUCF activities	• Separation of emissions from deforestation and from fossil fuels • Use of types of commitments best suitable for LULUCF • Uncertainty of emissions are less relevant	• More complex negotiations, as on two separate topics with new institutional structure • Agreement on climate change cannot be used for conservation of forests

The options given here range from a complete mixing of LULUCF emissions with other emissions on the one hand to a complete decoupling of the two on the other hand. It seems likely that the final agreement will lie in-between the two extremes. It seems likely that a selection of LULUCF activities and emissions are included in the basket of gases and sectors. The rules would be based on the current approach under the Kyoto Protocol but simplified and harmonised for the different activities. Such a compromise could satisfy most of the countries concerned.

V. Agreements on technology

i. Introduction

There is no doubt that 'technology' should play an important role in helping to reduce or limit greenhouse gas emissions. Especially the USA has put much emphasis on this aspect. Technology is both a cornerstone of the national US strategy with respect to climate change, but it is also a key input of the USA to the international debate on future action.

But also, in the European Union, the role of technology is acknowledged. In its recent communication, the European Commission proposes a combination of push and pull strategies to promote technological innovation. Factors such as establishing a fair market value for greenhouse gas emissions, abolishing subsidies that promote environmentally harmful technologies, and promoting policies to encourage the adaptation of new technologies are useful in pulling technological change. Coupled with sufficient R&D budgets to stimulate the market and innovation (i.e. pulling the market), new climate friendly technologies can be developed or further integrated into society¹⁴. This is also reflected in a recent speech by UK's Prime Minister Blair PM's speech at the World Economic Forum in Davos, Switzerland where he stated¹⁵:

"through the G8 process I want to develop a package of practical measures, largely focused on technology, to cut emissions. And here I don't just mean research into new technologies, important though that is. I also think we need to work much harder to find ways to implement the vast range of low-carbon technologies that have already been developed. Energy efficiency. Renewable energy sources. Cleaner fossil fuels. Avoiding waste. All of this can be done, and often at a much lower cost than we realise."

And although the detail below focuses on the USA and the EU, it should be kept in mind that technology is also a crucial element for developing countries. The key is to ensure that local technology needs are assessed and requirements met. Meeting the requirements of developing countries can also come from outside of the typical North-South technology transfer. Opportunities in increasing South-South transfers exist by creative use of funding and multilateral programmes and developing countries should not simply be viewed as donors in the technology circle. Problems experienced in developing countries may not be congruent with technological solutions from developed countries, and corresponding solutions may well be available in other developing countries. Developing countries can also play a role in developing and manufacturing appropriate technologies. A good example of the potential is what has occurred in the Chinese solar water heating market. In a relative short period of time, China has become the world's market and producer of solar water heaters.

All this raises the point whether 'technology' should be an element of a future agreement on climate change. The importance of technology was emphasised by Benedick (2001), Barrett (2003) and Brewer (2003).

In this section, we first give definitions of technology and related topics (section 5.V.i). Then we give a more elaborate description of how the USA deals with the topic (section 5.V.ii). Subsequently, the possible agreement types on 'technology' are considered (section 5.V.iii). Finally, the role of technology in a future climate agreement is considered (section 5.V.iv).

ii. Definitions of technology and innovation

There is a variety of definitions of technology. In the special report on technology transfer of the IPCC¹⁶ it is referred to as "know-how, experience and equipment, used by humans to produce services and transform resources". In the context technology is used in the climate debate, there is a strong emphasis on 'new' technology.

¹⁴ European Commission, Communication SEC(2005) 180, *Winning the Battle Against Global Climate Change*

¹⁵ <http://www.number-10.gov.uk/output/Page7006.asp> (26 January 2005)

¹⁶ Methodological and Technological Issues in Technology Transfer, IPCC Working Group III, Cambridge University Press, (2000)

This brings us to the topic of innovation. Innovation comprises “*implemented technologically new products and processes and significant technological improvement in products and processes. An innovation has been implemented if it has been either introduced on the market (product innovation) or used within a production process (process innovation)*”. Also innovation is a broad concept: it involve a series of scientific, technological, organisational, financial and commercial activities¹⁷. It is important to recognize that innovation is much more than research and development (R&D). Innovation expenditures include those on:

- R&D
- Acquisition of disembodied knowledge
- Acquisition of embodied technology
- Tooling up, industrial engineering, industrial design, production start-up (including pilot plant and prototypes insofar not included in R&D)
- Training linked to innovation activities
- Marketing for new or improved products

Innovation is not the only part of bringing new technology into operation. Traditionally, the sequence invention – innovation – diffusion is distinguished. In practice, deployment of new technology turns out to be a much more complicated process, where more stages and feedbacks can be distinguished (see Figure 26). Each stage in this process has it’s own actors and deserves it’s specific policies for stimulation.

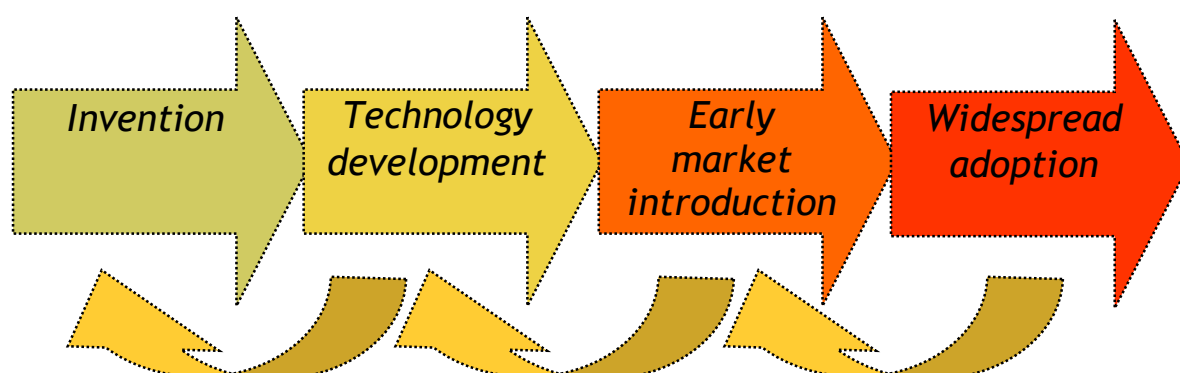


Figure 26: Schematic description of the process for the development deployment of new technology.

iii. The role of ‘technology’ in the USA

In the speech¹⁸ on June 11, 2001 in which US President G.W. Bush declared that “Kyoto is, in many ways, unrealistic”, he said the following about technology:

"We recognize our responsibility and will meet it -- at home, in our hemisphere, and in the world. My Cabinet-level working group on climate change is recommending a number of initial steps, and will continue to work on additional ideas. The working group proposes the United States help lead the way by advancing the science on climate change, advancing the technology to monitor and reduce greenhouse gases, and creating partnerships within our hemisphere and beyond to monitor and measure and mitigate emissions...."

And we propose a joint venture with the EU, Japan and others to develop state-of-the-art climate modelling that will help us better understand the causes and impacts of climate change. America's

¹⁷ Oslo Manual, OECD, Paris, 1997

¹⁸ <http://www.whitehouse.gov/news/releases/2001/06/20010611-2.html>

the leader in technology and innovation. We all believe technology offers great promise to significantly reduce emissions -- especially carbon capture, storage and sequestration technologies.

So we're creating the National Climate Change Technology Initiative to strengthen research at universities and national labs, to enhance partnerships in applied research, to develop improved technology for measuring and monitoring gross and net greenhouse gas emissions, and to fund demonstration projects for cutting-edge technologies, such as bioreactors and fuel cells."

The US Climate Change Technology Program¹⁹, which was started to implement the President's National Climate Change Technology Initiative, consists of a range of activities, including:

- The reduction of emissions from energy end-use and infrastructure (includes the FreedomCAR programme, advanced heavy-duty vehicles, zero energy homes and commercial buildings, solid-state lighting and superconductivity)
- The reduction of emissions from energy supply (includes the hydrogen fuel initiative, fuel cell systems, renewable energy and nuclear)
- Capturing and sequestering carbon dioxide (includes both geological storage and biological sequestration)
- The reduction of other greenhouse gases
- Measuring and monitoring greenhouse gas emissions
- Bolstering the contributions of basic science

Within this package, carbon sequestration has drawn most attention: the President explicitly mentioned this technology in his speech; it is an area where new initiatives have been taken (a roadmap); and the USA have taken an international initiative: the Carbon Sequestration Leadership Forum.

The Carbon Sequestration Technology Roadmap²⁰ sets out technology development programmes with a strong focus on cost reduction of carbon capture technology. Government expenditures on sequestration have increased from virtually zero in 1998 to 40 million US\$ in 2003.

However, the US government claims that the approach to climate change technology is broad – as was already set out in the Climate Change Technology Program. This can be confirmed by other sources. For instance, the US government's R&D expenditures for renewable energy amounted to about 250 million US\$ per year until 2002 (higher than those in the EU) and for energy efficiency about 550 million US\$ per year (much more than the EU)²¹.

Hence, the expenditure on carbon sequestration – until now – is but a small part of total expenditure on emission reduction options.

The following planned expenditures are given²²:

- energy efficiency technologies: more than \$700 million on technology development and \$500 million for accelerated deployment
- renewable energy: more than \$200 million

¹⁹ U.S. Climate Change Technology Program – Research and Current Activities, U.S. Department of Energy, Washington, November 2003, <http://www.climatechange.gov> and S. Abraham: The Bush Administration's Approach to Climate Change, Science, 305 (2004) 6.6 to 6.7, <http://www.climatechange.gov/library/2004/science-abraham30jul2004.htm>

²⁰ Carbon Sequestration – Technology Roadmap and Program Plan, U.S. DOE Office of Fossil Energy, Washington D.C., March 2003, <http://www.netl.doe.gov/coalpower/sequestration>.

²¹ Source of date: R&D database, International Energy Agency, Paris, www.iea.org, accessed 2003, 2004.

²² S. Abraham: The Bush Administration's Approach to Climate Change, Science, 305 (2004) 6.6 to 6.7, <http://www.climatechange.gov/library/2004/science-abraham30jul2004.htm>

- hydrogen economy: Hydrogen Fuel Initiative and Freedom-CAR Partnership: \$1.7 billion over 5 years (\$340 billion per year)

An important characteristic of the US approach is the focus on the longer term. For instance, in the case of carbon sequestration the focus is on commercial deployment of the technologies between 2012 and 2018. Another illustration of the longer-term focus can be found in the area of energy efficiency of passenger cars. Under President Clinton, the Partnership for a New Generation of Vehicles (PNGV) was agreed, aiming at prototype passenger cars in 2005 that are three times as efficient as those in 1993. Under President Bush, this was replaced by the FreedomCAR programme with the much more generally phrased long-term goal “to develop technologies for hydrogen-powered fuel cell vehicles that will require no foreign oil and emit no harmful pollutants or greenhouse gases”.

A picture in an earlier version of the Carbon Sequestration Technology Roadmap is illustrative (see Figure 27). This picture shows increasing emissions for the USA until 2020, then stabilisation until 2040 and a decline in emissions thereafter. Such a development seems to be hardly compatible with any development towards a climate target that aims at a maximum increase of temperature of 2 °C above pre-industrial levels.²³ However, it must be noted that the picture is from one of the work documents in the preparation of the Climate Change Technology Program and does not reflect US policy in a formal way.

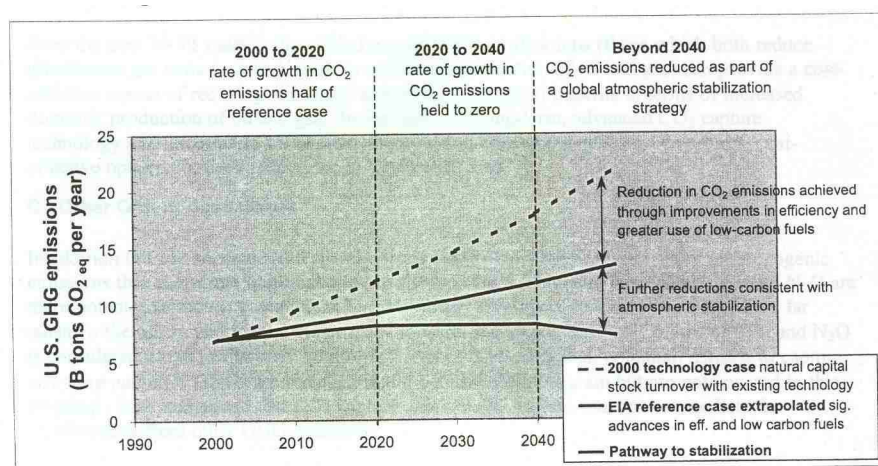


Figure 27: Possible development of GHG emission and response options²⁴

A topic that is sometimes quoted, but that plays no perceptible role in US policy is 'geo-engineering'. Geo-engineering includes the enhancement of oceanic carbon sinks (e.g. through iron-fertilization) and shielding part of the sunlight (e.g. through injection of particles in the stratosphere). Despite the fact that geo-engineering is often connected to 'technology', no concrete examples of US government initiatives in this direction were found. Nevertheless, geo-engineering is seriously studied and debated in the US²⁵

How should the USA's position be assessed?

Hardly anyone will question the importance of 'technology' as a major cornerstone in solving the problem of climate change. As such, the USA's attention towards this issue is not the actual problem.

²³ European Council 1996: "Communication on Community strategy on climate change", Council conclusions, 25 to 26 June 1996, European Council, Brussels and European-Council, 2005: "Presidency conclusions", European Council, Brussels

²⁴ Carbon Sequestration – Technology Roadmap, U.S. DOE Office of Fossil Energy, Washington D.C., January 2002.

²⁵ See e.g. B. Govindasamy, K. Caldeira, P.B. Duffy: Geoengineering Earth's radiation balance to mitigate climate change from a quadrupling of CO₂, *Global and Planetary Change* 37 (2003) 157-168 from scientists from Lawrence Livermore National Lab's. The authors conclude that curtailing emissions may well be the most prudent and least risky option to mitigate global warming, but that it is useful to study geoengineering that may provide options in the event that greenhouse gas emissions induce catastrophic climate responses.

One could also not argue that the problem is that the USA's technology focus is too narrow – the USA develops a wide variety of response options; the portfolio is very much comparable to the portfolio in the EU.

The actual problem²⁶ is that the USA's focus is primarily on developing emission reduction technologies and not deploying them, and therefore effectively postponing action. Postponement of action by the USA may well make it impossible to reach ambitious climate stabilization targets.

In addition, it is possible that the USA's strategy will miss its own aim, as it overlooks the importance of 'learning'. Cost reduction of technologies may be reached by carrying out R&D, but more importantly, cost reduction will be reached through the practical application of the technology (through learning-by-doing, upscaling, etc.). Postponing technology deployment can therefore mean postponing the cost reduction and will hence lead to a vicious circle.

iv. The role of 'technology' in a future protocol

Despite broad acceptance on the important role technology has to play, it is not so easy to envisage what a Technology Protocol would look like. Before coming to an outline, it is important to distinguish various elements that might be included.

To begin with, a general agreement on technological development is already provided in the Climate Convention. Article 4.5 of the United Nations Framework Convention on Climate Change states:

"The developed country Parties and other developed Parties included in Annex II shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention. In this process, the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country Parties. Other Parties and organizations in a position to do so may also assist in facilitating the transfer of such technologies."

Additional agreement could be reached for different targets types. Regarding the target types one can make two important distinctions:

- a focus on *development* of new technology versus *deployment* of existing (or new) technology
- a focus on input to action (effort-based) versus output of action (result based).

This provides us with the matrix of possible actions presented in Table 16.

Next to this, also more general agreements could be attained on the exchange of technology, ranging from 'soft' to 'hard' forms, e.g. exchange of information, capacity building, transfer of licences, transfer of equipment.

Table 16: Possible target types for agreements on technology

	Input (effort-based)	Output (result-based)
Focus on technology development	1. Agreement on input (money, people) for research and technological development , e.g. a certain percentage of GDP to be spend on the development of climate-friendly technologies	2. Agreement on performance targets for technologies resulting from research and technological development , e.g. developing of concrete targets for new technologies with respect to conversion efficiency levels or cost-effectiveness
Focus on	3. Agreements on efforts to	4. Agreements on targets for the

²⁶ Assuming that we base ourselves on the stated aims of the U.S. government, thereby for the moment overlooking that there are strong forces in the U.S. government and society that have as the main aim to postpone action.

technology deployment	implement new technologies , e.g. in terms of policies and measures to be implemented	implementation of new technologies , such as average efficiency performance targets or targets for the share of renewable energy sources
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A number of technology areas can also be distinguished:

- energy efficiency in buildings (including electric appliances)
- energy efficient and clean cars (and other means of transportation)
- energy efficiency and GHG emission reduction in the manufacturing industry
- renewable energy
- clean fossil fuels (including CO₂ storage and sequestration, hydrogen routes)
- nuclear
- low GHG agriculture

It is clear that preferences on these technologies differ across countries. Some areas are not relevant for all the countries. An important point for developing countries will be the degree to which the new technologies contribute to sustainable development. Nevertheless, it is clear that ambitious climate targets are only achievable if substantial progress is made in a number of these areas²⁷.

Before conclusions can be drawn about the possible role of technology in a future protocol, it is important to acknowledge that there are different ways how "technology" can be treated in a future protocol.

1. Technology is an element of a protocol that is completely additional to other elements, like agreements on quantified emission targets and on adaptation.
2. Similarly, technology is one of the elements of a protocol, but in this variant 'trading' between various elements is possible. For instance, a country might put extra effort in developing new technology that can strongly reduce emissions in the long run, but in exchange have a higher emission target in the short term.
3. A third possibility is a completely separate agreement only on technology (without an agreement on quantified emission reduction targets).

In case of the first option, *technology as part of a broader agreement*, the parties to the protocol may agree on various types of agreements (input-based or output-based, technology development or technology deployment) in one or more of the technology areas. In contrast to a protocol-on-technology-only, this approach seems relatively easy to deal with, as the environmental integrity of the protocol does not primarily depend on this part of the agreement. A potential pitfall is that the technology item is seen as not more than the cream on the protocol and that the protocol text has little impact (compare Article 4.5 of the UNFCCC). This would not be in line with the importance that is attached to this issue by many of the Parties.

The second option, *'tradability' between technology and short-term emission reduction targets*, could be implemented in a protocol as the general possibility to replace short-term action by technology development. No concrete technology agreements need to be made. If countries come up with a proposal on a technology trajectory a procedure should be in place to certify, monitor and verify the alternative pathway (comparable to the procedures now in place for the Clean Development Mechanism). It will not be an easy task to safeguard environmental integrity in this case: the conversion of short-term activity into long-term activity vice versa is far from straightforward. Also, it is

²⁷ E.g. for the European Union it was calculated that in order to reach long term targets for climate change, e.g. 60 – 80% reduction of greenhouse gas emissions by the year 2050, the following CO₂ emission reduction actions are necessary:

- an average energy efficiency improvement of 2 – 3% per year
- a contribution of (near) zero emission sources of about 50% of the current energy demand per year in the mid of this century

(Source: Blok, K., *Technology choices: how to set innovation targets for energy-efficiency improvement and low-carbon energy sources?*, August 2004).

difficult to compare technology development and deployment efforts with short-term GHG reduction efforts.

A variant of this approach is that the 'trading' is already done during the protocol negotiations: some countries may primarily focus on emission reduction objectives, whereas others exchange part of the commitment in this area by commitments on technology development.

In the third option, *a separate agreement on technology*, the credibility of the agreement is most crucial. An agreement could – as an example - have the following structure:

- that each individual country subscribes to an effort in a number of the technology areas listed in the previous section (for instance Annex I countries on 4-5 areas and Non-Annex I countries on 1-3 areas)
- that the equivalence of effort is measured in its contribution to greenhouse gas emission reduction for the year 2050
- that for each area, elaborated targets are developed jointly (these can be developed in follow-up protocols to ease the negotiation process)
- that these targets can be pursued by countries either individually or jointly²⁸

Establishing a separate protocol with a menu approach has the advantage that it contains interesting elements for everyone. Also, it may be a good way to enhance efforts in developing countries and it can act as a catalyst in bridging the gap towards a final agreement on future action.

However, it is a relatively soft agreement in terms of environmental impact as the real emission reduction effects can only be monitored on the long term. Reaching an agreement may not be that easy, as the modalities need to be fairly detailed to guarantee a minimum of environmental integrity. Reaching an agreement can be eased by applying a phased negotiation process (first agree on a framework agree, with the elements being gradually filled in: first general rules and then rules on the individual technology areas).

It still remains to be seen whether a separate agreement on technology is acceptable to the USA. Although technology might be viewed as the ultimate way to accommodate to the USA's position, it is still unclear just how the USA will enter into detailed commitments on technology.

v. Conclusions on technology

In the previous sections, we have set out the various issues at stake when we talk about the inclusion of 'technology' in a future climate protocol. Although the relevance of technology is widely acknowledged, it is far from straightforward how it should be included in a protocol.

A lot of choices can be made, e.g. the role in the protocol (additional, tradable or stand-alone), on the technology areas to be included and the type of commitments (input-based or output-based; technology development or deployment or both). It would be useful to elaborate a possible technology protocol for a concrete technology.

Anyway, included technology in a climate protocol can be important for reaching long-term climate targets. Therefore, it is worthwhile to try to negotiate concrete agreements in this area (option 1 in the previous section). In the course of the overall protocol negotiations, some exchange with other elements of the protocol may be considered.

²⁸ Joint action might range from a joint R&D programme on CO₂ sequestration to a common emission trading system for industrial emissions.

VI. A proposal for a new regime

Based on the previous sections, we can summarise the following recommendation for a new regime, containing the following elements.

- A multi-stage agreement on emission reductions including the flexibility mechanisms of the Kyoto Protocol with the following stages
 - A. An extended Annex-I with emission reduction commitments for 2013 – 2022 in the range of 15-30% compared to 1990, to be differentiated according to some sectoral approach
 - B. An intermediate group (currently between 5 and 9 tonne CO₂-eq. per capita, excluding LUC) with emission reduction commitments for the period 2013 to 2022 equivalent to stabilizing emissions per capita, to be differentiated according to an individual approach and only for countries with more than \$4000/GDP per capita.
 - C. A third group with low emissions per capita and/or low GDP per capita with no quantitative commitments
- An agreement on an adaptation fund to be filled by Group A countries increasing from 0.1 – 1.0 \$/tonne CO₂ per capita. Group B countries pay half the rate. Group C countries can make use of the fund, but have to pay an own contribution of half the rate
- An agreement on all forest/LUC emissions on managed lands in the Kyoto basket
- An agreement to develop low-cost clean technology in the areas: advanced biomass utilization and photovoltaics, carbon sequestration and hydrogen/fuel cells, advanced industrial processes

This regime might be acceptable to most countries. Several options exist to consider the particular situation of the USA:

- **New base year:** One option could include setting the base year for establishing future emission reduction targets to a date after 1990 or, as Bodansky (2002) suggests, assign a relative target (emissions relative to GDP). Intensity targets are also the principle approach in the current climate strategy for the USA, but any effective reduction in emission reductions would require stringent reductions from other countries.
- **Differentiate within Annex-I:** More than in the Kyoto Protocol, differentiation would take place with less stringent targets for the USA. However, given the weight of the USA in total Annex-I emissions, it is hard to conceive how that average would remain on the 15-30% reduction level (compared to 1990)
- **Targets with price cap:** A option where a price cap on targets could be applied. A range from 50 to 100 US dollars per tonne of CO₂-eq is a possibility.
- **Intensity targets:** In this option, emission targets are expressed dynamically as a function of GDP. Intensity targets could be set as stringent as absolute targets although its use needs to be considered with care since setting such targets is difficult as it involves additional knowledge about the relation between emissions and GDP. A rate of 4% per year could act as the guiding light.
- **Emphasis on technology:** One possibility concerning final involvement by the USA is to leverage the emphasis the country places on the importance of developing new technologies. It will, however, be difficult to achieve a protocol based on technology alone, where environmental integrity is safeguarded.
- **Emphasis on market mechanisms:** Cost-effectiveness and market mechanisms, such as emission trading, are also important for the USA, and this will remain so for post-2012 policies. However, the Kyoto Protocol already contains a number of flexible mechanisms and it is difficult to envisage how that can be envisaged.

- **Nevertheless reduce:** One option would be to take measures to reduce emissions together with likeminded countries without the inclusion of the USA. Competitiveness concerns would be an argument against that option. Moreover, it will be difficult to get higher involvement from developing countries. This will probably make it a weak protocol.

Given the difficulty to achieve agreement including the USA and without the US, the negotiation community should be prepared to accept a fall-back option. If it is not possible to agree on a full and ambitious package as outlined above, an alternative to the above approach could possibly be a *multi-phase approach*. A multi-phase approach is an approach where the negotiations go through various phases and commitments are gradually strengthened.

An example of a first phase could be:

- Maximum binding emission level for Annex-I countries and other high-GHG/cap countries (these caps could be considered as the upper level of a dual-cap system to be introduced later):
 - For Kyoto Protocol parties at the Kyoto-level
 - For others at the level of current emissions
- Sectoral agreement for energy-intensive industries (this makes it possible for individual countries or country groupings to take further measures without hurting their economies)
- Adaptation fund at a level sufficient level to pay for the first rounds of NAPA implementation.
- Framework agreement on technology, to be gradually elaborated and filled in for concrete technology areas. Development of a system of certification, monitoring and verification for this area (should be suitable for a later tradable element of the agreement)
- CDM remains in place.
- Revision of the protocol every two years

Impact of delay of action

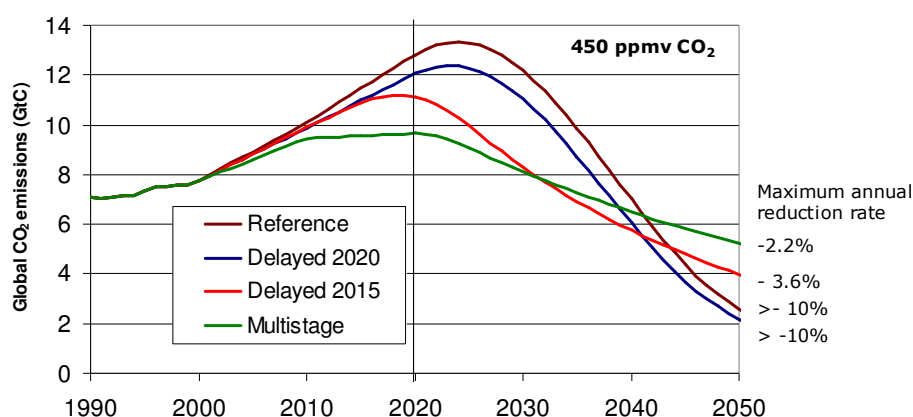
However, a delay of only a few years has considerable consequences on the ability to keep CO₂ concentrations below 450 ppmv. We used the EVOC tool (Höhne et al. 2005) to demonstrate this. Figure 28 shows global CO₂ emissions until 2020 under four cases:

- **Reference:** A reference case with no climate action based on IPCC SRES scenario A1B
- **Delayed 2020:** A delayed case where the countries that ratified the Kyoto Protocol achieve their Kyoto targets and stay on that level. All other countries follow their reference. Global reductions start as of 2020
- **Delayed 2015:** A delayed case where the countries that ratified the Kyoto Protocol achieve their Kyoto targets, stay on that level. All other countries follow their reference. Global reductions start as of 2015
- **Multistage:** The multistage agreement as described above

After 2020, emission paths are shown that would ensure that CO₂ concentration stays below 450 ppmv. We assume that global emission reductions start as of 2020 except for 'delayed 2015' where they start in 2015. As global emission trend are unlikely change drastically from one year to the next, we represented this inertia in a simplified manner: the global emission trend cannot change more than 0.5 percentage points per year. For a detailed description of this methodology see Höhne and Blok (2005).

One can observe from Figure 28, that following the reference case or the delay until 2020 would make it virtually impossible to stay below 450 ppmv, only with global reduction rates after 2020 higher than 10% per year. Already the delay of 5 years increases the global reduction rate per year after 2020 considerably (here from 2.2% to 3.6%). If it were aimed at 550 ppmv CO₂ concentration, the difference between the cases would be less pronounced, as the peak in global emissions to stay below 550 ppmv may occur later in the century but still before 2040/2050.

Figure 28. Global CO₂ emissions under several scenarios until 2020 and emission pathways towards stabilization of CO₂ concentration at 450 ppmv



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5. Scenario of a possible negotiation process²⁹

I. The post-2012 agreement framework

In Chapter 4 we presented elements of a possible future climate policy regime. The following four main elements in an agreement framework were discussed:

1. Multi-stage agreement on emission reductions of Kyoto gases.
2. Agreement on LULUCF.
3. Agreement on adaptation.
4. Agreement on technology.

In this section we outline a negotiation process that would be helpful and potentially decisive for achieving such agreements through international negotiations, and where the EU could play a pivotal role.

The next section of the analysis outlines two scenarios for future agreements, which we have denoted by 'early agreement', where agreement turns out as feasible before 2008, or 'delayed agreement', where agreement on further action is only possible later. In the third section of the analysis the focus is on the differing interests of key parties and building alliances to move negotiations forward. Next we explore how the negotiations should be best organized followed by a brief discussion of major pitfalls to be avoided and conclusions with policy advice. A more theoretical discussion of key elements of the negotiation process is provided in an annex.

II. Negotiation scenarios: early or delayed post-2012 agreement

i. Early agreement

In the early agreement scenario negotiations on post-2012 action turn out successfully before 2008, the first year of Kyoto Protocol period.

We assume that negotiations are finalized by the end of 2007, just in time for the first commitment period under the Kyoto Protocol (see Figure 29). There are four negotiation phases:

1. Make preparations and undertake bilateral consultations till November 2005.
2. Agree on formal negotiations at COP 11/MOP1 in Montreal in November/December 2005.
3. Start negotiations by January 2006.
4. Agreement by November 2007 (COP 13).

²⁹ We thank Michelle Twena, CICERO, for co-authoring chapter 5 and Guri Bang, CICERO, for valuable suggestions and comments to the same chapter.

Time table

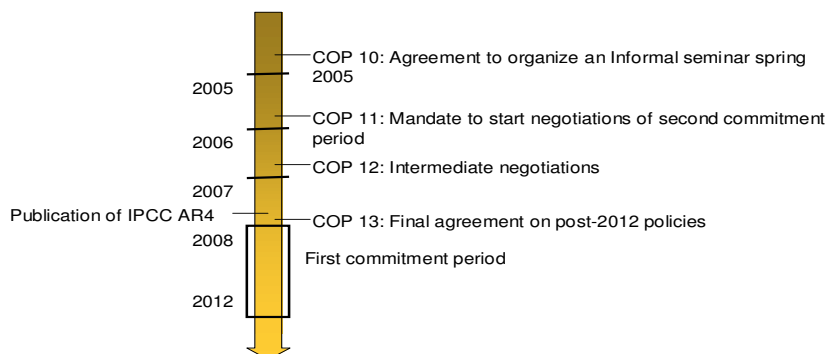


Figure 29: Timeline of Post-2012 agreement negotiations

At COP10 in Buenos Aires in December 2004 there was only agreement to organize a seminar in May 2005 in conjunction with meetings of the subsidiary bodies under the UNFCCC in Bonn to exchange information on existing policies and measures and “promote an informal exchange of information on actions relating to mitigation and adaptation to assist Parties to continue to develop effective and appropriate responses to climate change”. The seminar was to be managed “without prejudice to any future negotiations, commitments, processes, frameworks or mandates under the UNFCCC”. The seminar did not have a clear mandate to guide the UNFCCC process, but proceedings will be available. At the seminar, several Parties called for a “Montreal Mandate” to start negotiations on the Post-2012 period.

ii. Delayed agreement

In this scenario agreement before 2008 turns out to be impossible and is first reached around 2012. This is too late for the period 2013 - 2017 so this becomes an intermediate period of no further action. New actions are first possible from 2018.

In this scenario there are three phases:

1. Negotiations on a mandate for post-2012 action; initiation of negotiations but fail until 2012.
2. An intermediate period of no further action 2013 - 2017.
3. The new agreement is implemented for the target period 2018 - 2022.

In the intermediate period the EU and other Kyoto partners may choose to uphold the emission level specified by the Kyoto Protocol, or relax their policies in the absence of agreement and participation by USA and other key countries, leading to increased emissions.

iii. Relation to strong and weak agreement scenarios

A weak scenario can be seen as a fall-back option in the eventuality that a strong agreement turns out to be impossible to achieve. The most straightforward combination of these scenarios and the early or delayed agreements discussed above are strong/early and weak/delayed, although the combinations strong/delayed and weak/early are possible. The combinations are shown in Table 17.

Table 17: Negotiation scenarios. An example of a strong agreement is the package described in section 4.VI. An example of a weak agreement is the fall-back option described in the same section.

Time	Early	Delayed
Agreement type		
Strong	Agreement before 2008 Multi-stage, LULUCF, adaptation, and technology agreements	Agreement around 2012 Multi-stage, LULUCF, adaptation, and technology agreements
Weak (fall-back)	Agreement before 2008 Multi-phase; Kyoto-level or current level emissions; sector agreement; adaptation fund; framework technology agreement	Agreement around 2012 Multi-phase; Kyoto-level or current level emissions; sector agreement; adaptation fund; framework technology agreement

The feasibility of the strong/early scenario could be improved through issue-linkage (see section III.i and ii) since each party is likely to find at least one agreement element that has high interest. In other words there should be something in it for everyone.

The strong/delayed scenario is thinkable if early agreement turns out impossible, but stronger indications of serious consequences of man-made climate change is seen after 2012.

The weak/early scenario is thinkable if the pro-active parties realize early that a strong agreement for now is impossible, and instead go for a weak agreement for the first years of the post-2012 target period.

III. Organization of negotiations

i. Linking agreement elements

There are both pro and contra arguments for closely linking negotiations on the four agreement elements Multi-stage, LULUCF, Adaptation and Technology.

Arguments for linking the four agreement elements relatively closely:

1. Enhance flexibility and transparency in terms of countries choosing different profiles with respect to commitments in the four areas.
2. The four elements reflect interests of different country groupings.
3. Enhanced possibility for recognising interrelations and overlapping areas between the four agreement components.

According to national circumstances and interests a party could choose more stringent commitments with respect to e.g. the multi-stage agreement and softer commitments with respect to the technology agreement, whereas another party might make just the opposite choice.

Arguments for a weaker link between the four agreement elements:

1. Reduce complexity and enhance negotiation feasibility.
2. There is no strong inter-linkage between the four agreement elements.

Before concluding on the linking issue we discuss other important questions, where the first is dependency between the agreement components.

ii. Dependency between agreement elements

An assessment of inter-linkages between the four agreement elements is a first step in the discussion of how negotiations should be organized. Table 18 presents our assessment of potential inter-linkages.

Table 18: Inter-linkages between the four agreement components. W: weak; M: moderate; S: strong.

	Multi-stage	LULUCF	Adaptation
LULUCF	M		
Adaptation	W	W	
Technology	M	W	W ³⁰

There are no strong inter-dependencies according to our evaluation. However, we find a medium dependency between multi-stage and LULUCF based on the assumption that CO₂ sequestration in forests and soils is one option for limiting national GHG emissions in a multi-stage agreement. There is also a medium inter-dependency between multi-stage and technology since technological improvements will be essential for meeting long-term emission caps or emission intensity caps in a multi-stage framework, both for industrialized countries and developing countries. The proposed levy on GHG emissions in Annex I countries to finance adaptation activities in developing countries can be seen as a 'side payment' generating a stronger link between Multi-stage and Adaptation. (It might also induce some developing countries to earlier take on Annex I type commitments). Despite only weak-medium links between the agreement framework elements, there is nevertheless a case for presenting them as integral parts of the negotiation process.

iii. Platform for negotiations

The UNFCCC provides the natural platform for formal and 'semi-formal' discussions to take place, not only because the USA has signed up to the Climate Convention, but also because it has a much broader support base internationally than the Kyoto process. Dialogue may potentially take place at the May seminar in Bonn, COPs, and subsidiary bodies, e.g. SBSTA and SBI (the Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation, respectively). As the USA can only participate at MOP meetings as an observer, taking advantage of the institutional infrastructure offered by UNFCCC networks is likely to be a pragmatic way forward.

Building additional levels into the process could also bring further benefits (Sugiyama et al. 2003), for example, informal bilateral and multilateral talks with key actors could supplement more formal negotiations within the UNFCCC. First, they could be mutually reinforcing, allowing bilateral and regional discussions to progress at a faster pace, and in turn, providing useful inputs to the slower-moving global process. Second, not only can informal negotiations inject momentum into the proceedings and represent valuable communications channels, but they can also provide a contingency plan should formal negotiation processes fail.

iv. Sequence of negotiations

Since there are some inter-linkages between a Multi-stage agreement, Technology and LULUCF (see section ii above), which all relate to mitigation, there are advantages to co-ordinating negotiations on these components, even at the cost of larger complexity in negotiations. In terms of sequence it seems reasonable to first initiate negotiations on a Multi-stage agreement, since this will provide the architecture of overall climate policy collaboration. When the Multi-stage negotiations have made sufficient progress negotiations on the Technology, LULUCF and Adaptation elements should be initiated.

³⁰ A medium inter-linkage if technology development includes adaptation technologies.

v. Negotiations in the delayed agreement scenario

In the delayed agreement scenario negotiations fail before 2008 and throughout the Kyoto period 2008-2012. Agreement on a mandate is first possible in a later stage, and the new agreement reached around 2012. This means an intermediate period of no formal post-2012 action agreement following the Kyoto Protocol. Thus negotiations must be framed under the UNFCCC. One advantage of this situation is that the USA and Australia, which have not ratified the Kyoto Protocol, can fully participate in the negotiations. The intermediate period with no binding commitments and “distance” to the Kyoto Protocol might enhance negotiations beyond the Protocol and with broader participation. On the other hand the loss of momentum in negotiations and in terms of incentives to reduce GHG emissions is likely to be problematic. There is a risk that some of the negotiation capacity is spent on “re-negotiating” the most viable components of the Kyoto Protocol. Therefore, on the EU’s part it is important to keep the components of the Kyoto Protocol that are most valuable for further action also in the intermediate period. In addition to flexibility mechanisms these are reporting and verification systems, a basket of GHG that opens for substitution between gases, differentiation of commitments across countries, and time flexibility (e.g. banking of emission allowances).

IV. Building alliances with key negotiation partners

As a potential leader, the EU could significantly boost its credibility by using the pre-negotiation period to play to the interests of key partners, build coalitions to re-engage sceptics, and promote the participation of non-governmental actors. It is essential to understand the interests and views of other parties, and respect their external and domestic limitations on what types of agreements that are acceptable.

i. Assessing interests of key countries

Multi-stage agreement on emission reductions of Kyoto gases

Increased flexibility through a staged approach is likely to make a global agreement attractive to a broader range of interests and consequently also countries. This could appeal to the USA and key developing countries because it would allow pursuit of flexible emission targets, such as intensity targets, and would incorporate developing countries into a system where they would eventually undertake emission reduction commitments. On the other hand some developing countries may be concerned that the G77/China grouping under the multi-stage approach eventually would be divided into different groups (stages) and therefore would lose substantial influence in the negotiations. On this background developing countries could be sceptic to the multi-stage agreement framework.

Agreement on LULUCF

There are four different potential forms of agreement on LULUCF mentioned in Chapter 4.IV. These are the continuation of existing approach, separate emission targets for LULUCF activities, different types of targets for LULUCF activities, and a separate protocol for LULUCF activities. Provided a balance between the interests of industrialized and developing countries and between developing countries with positive and negative carbon sequestration balances can be struck, a LULUCF agreement should be attractive or at least acceptable to key countries. One of the negotiation issues could be financial support from industrialized to developing countries to achieve some level of forest protection.

Agreement on adaptation

Giving a more even treatment to impacts, adaptation and vulnerability alongside mitigation in future negotiations would demonstrate a clear willingness on the part of the EU to address the concerns of the G77/China and thus remove a major obstacle to reaching an agreement. The failure of COP8 to initiate discussion of post-2012 commitments has in part been attributed to the reluctance of Annex I (minus the US) to credit adaptation with a more central role (see e.g. Ott 2003). This theme should therefore play a central role in any future climate agreement.

Agreement on technology

Sending out the clear message that addressing climate change provides an *opportunity* to stimulate the economy rather than a threat to growth is perhaps one of the most promising means of engaging the USA in the climate policy process. An EU “vision on climate technology” could be developed to explore opportunities for cooperation with the USA on technology development. Emphasizing competitiveness – an area of common interest for the EU and the USA – may appeal to the instincts of

the USA and establish mutually beneficial political and economic partnerships that can be built upon in the future. Technology transfer might also be a way of bringing key developing countries, such as China, into a climate partnership. It would no doubt also be of interest to important technological innovators like Japan. Further, efforts currently underway to highlight the synergies between climate mitigation/adaptation and technological innovation should be reinforced.

Error! Reference source not found. presents a summary of our assessment of key parties' interest for the four agreement elements.

Table 19: Assessment of key parties' interest for the agreement elements. H: high interest; M: medium interest; L: low interest.

Party	Multi-stage	LULUCF/Forest	Adaptation	Technology
China	L	M	H	H
India	L	M	H	H
Indonesia	L	L	H	M
South Africa	M	M	H	M
Brazil	L	L	H	M
Mexico	M	M	H	H
Saudi Arabia	L	M	H	M
South Korea	M	M	M	H
Australia	M	M	M	H
Japan	M	M	M	H
Canada	H	H	M	H
Russia	M	H	L	H
Ukraine	M	H	L	H
The USA	M	M	L	H
The EU	H	M	M	H

According to this assessment there is something for all key countries in the four-element agreement framework proposed in the sense that there is high interest for at least one element. Some countries have high interest for two elements and one country for even three elements. At the other end of the scale about half of the countries have low interest in one or two elements. All in all this means that the proposed agreement framework could be acceptable to key countries as long as they are willing to compromise, that is accept that some low-interest elements are included as long as high-interest elements are also included (i.e. some type of side payment). Therefore the multi-element agreement where countries can give some and take some could be vital for political feasibility.

ii. Linking with other issues

It has been argued (Haas 1980) that making issue linkages can offer greater hope for an efficient outcome when international negotiations revolve around a dynamic issue where knowledge is uncertain and solutions are unclear, such as climate change. When issues that were previously viewed as unrelated or even conflicting can become linked, it can lead to global cooperation, through a process of learning. This process can be interpreted as a realignment of interests so that the perceived benefits accrued to the different parties shift from incompatibility to congruence. Issue linkage can also be seen as a type of "side payments", where a party accepts stringent commitments in one area against concessions in other areas dependent on national interests. A party must accept the interests and views of other parties, and its constraints on acceptability given internal political and public opinion conditions. Other climate-related issues could therefore provide a basis for making linkages and reframing the climate change question such that the room for manoeuvring in negotiations increase, and the ability to identify areas of common interest increases.

The main linkage issues considered here are development and climate, co-benefits in developing countries, air pollution agreements, green technologies, and energy security. Given that this linking strategy is successful earlier headway in negotiations might be possible.

Development and climate

Mainstreaming climate policy into development issues is important for persuading developing countries that climate change is relevant to them. Key actors such as China, Brazil and India see development as a primary concern and only by framing the climate issue as a development question can broad cooperation be expected.

Air pollution agreements

As many emissions sources release substances that are harmful to climate and air quality, integrating climate policy and air pollution agreements could provide a cost-effective solution to two environmental problems. While developing countries are primarily concerned with the immediate problems associated with local and regional pollution, reducing emissions as part of a dual climate-air pollution effort would potentially benefit not only local and regional inhabitants, but also their continental neighbours (e.g. the US, who receives airborne particles from Asia) and the global community (Rypdal et al. 2004; Holloway et al. 2003).

Co-benefits in developing countries

Policies to reduce GHG emissions, and in particular CO₂ emissions from fossil fuels, often have co-benefits in terms of reduced emissions of aerosols, NO_x, SO₂ and other air pollutants. The co-benefits in terms of reduced health problems, crop damage, and corrosion are substantial in many developing countries, especially in large cities with high exposures of air pollutants. In many cases these co-benefits have a higher priority for a developing country than potential benefits of reduced climate change, and may thus be a more important motivation factor than long-term climate benefits.

Green technologies

Substantial long-term mitigation of GHG emissions requires development and deployment of new climate-friendly or green technologies. These are low- or zero-emission technologies. Aside from climate benefits and air pollution co-benefits such technologies are interesting for both developing and industrialized countries due to the energy-saving potential and the opportunity to develop new industries that can have a share of upcoming markets for green technologies. In addition there are positive connotations to the newest and most efficient technologies for all countries.

Energy security

Another "co-benefit" of climate policy and green technologies is due to reduced use of fossil fuels and thereby reduced dependency on fossil fuel imports, and in particular oil imports from politically unstable regions such as the Middle East. Petroleum imports can be a potential trigger for climate policy change if it becomes an economic and a security burden for the USA, especially if and when domestic reserves have been exhausted. For instance, the USA is facing increased competition on the demand side for oil. India, sharing an increased industrialization and economic boom, has joined China in a growing thirst for oil and natural gas. The two most populous countries in the world are bidding up energy prices and racing against each other and global energy companies. Finding alternatives to petroleum might then become urgent for the USA, and might potentially trigger changes in energy policy that have second-order effects for climate politics. Hence, the issue-linkage between energy and climate policy might be a trigger for change. The time-horizon for such a change is, however, most likely long. Domestic petroleum sources, combined with petroleum imports from more politically stable parts of the world than the Middle East, can supply the US market for years to come.

iii. A coalition of the willing

A coalition of the willing could inject momentum into the negotiation process for further action, even though the Kyoto Protocol partners that have taken on commitments to reduce emissions in many ways constitute such a coalition. Potential partners include industrialised countries such as Canada, the EU, Japan, New Zealand, and Norway, and also the Environmental Integrity Group (currently, Mexico, the Republic of Korea and Switzerland). This could supplement efforts to re-engage less eager partners, and act as a means of reinforcing rather than undermining a wider UNFCCC process seeking to achieve consensus at the global level. As a team, this coalition could lead by example; it could demonstrate its commitment to the climate cause by implementing ambitious climate policy targets, as far as possible harmonizing domestic policies, developing collaboration forms that could be of interest to a wider group of countries, and acting as a springboard for climate policy innovation.

iv. Building bridges

Given the diversity of opinions and interests in the climate policy debate, it is likely that different partners will be valuable in different issue areas and for different reasons. In some cases, like-minded allies will be important; for example, the EU, and Japan could form a natural alliance in promoting climate-friendly technology development and transfer. In other cases, it might be important to try to unite a cross-section of viewpoints in order to seek to identify a broader consensus. It is for this reason that a "New Triangle approach" has been proposed, focusing on dialogue between the EU, the USA and China (see first interim report for this project). Some have suggested that Russia could join this trio (Susskind and Ozawa 1992). Bringing together powerful representatives from key camps (in this case: climate-committed; industrialised climate-sceptics; and developing countries) challenges a few

actors to identify a common interest and reach a consensus that could have considerable international resonance.

v. Engaging the USA

It is of vital interest to engage the USA in climate policy collaboration due to its large share of global GHG emissions and the difficulties of involving developing countries in stronger efforts to limit their emissions without the USA's participation. The early agreement scenario is questionable in the case of the USA. At COP10 the USA stated that post-2012 negotiations are "premature". Instigating discussions both within and outside the Kyoto regime would be prudent given that the USA cannot fully participate at MOP meetings from COP11 (2005) onwards; the USA will only be granted observer status at COP/MOP sessions.

A combined approach could potentially provide the best way forward to try to engage the USA. To start with traditional means, the EU (and possibly a small group of others) could engage in bilateral talks with the US Government to gain a better understanding of their concerns and identify scope for compromise.

In addition, internal processes already underway in the USA could be supported politically and even financially (Ott et al. 2004). This could take the form of providing support to states, industry, interest groups, and scientific and local communities that welcome a more pro-active climate policy. Alliances could also be forged between the EU and sympathetic domestic political allies in the USA (e.g. the McCain-Lieberman coalition in the Senate, and political leaders in the pro-active Northeast states). However, the federal administration might dislike such 'interference' with domestic policies.

Another suggestion is to let part of the negotiations be organized under the UNFCCC and not only the Kyoto Protocol, since the USA has ratified the UNFCCC and has emphasized its willingness to adhere to this agreement.

The next alternative is to emphasize that post-2012 negotiations aim at more flexible climate policy collaboration than the absolute cap on emissions of the Kyoto Protocol. Thus countries should be allowed to choose modes of participation such as absolute emission cap, intensity target (emissions relative to GDP), targets with price cap, introducing technology standards, and investing in research and development of climate-friendly technologies. Thus a country could choose a mix of these participation modes and need not accept an absolute cap on emissions. The USA already has a national intensity target, technology standards, and is funding technology development.

Another option to enhance flexibility for the benefit of USA is to allow a later base year than 1990. However, the implied reduction in stringency of the target would be hard to sell to countries with more stringent targets. Furthermore, we suggest that the EU engages in collaboration with the USA in all available climate-relevant areas that are of interest to the USA, for example smaller country groups outside of the UN process, joint efforts to develop climate-friendly technologies (confer the technology partnerships initiated by the USA), or developing coordinated emission trading schemes.

vi. Involving non-state actors

Understanding that states are not unitary actors, but must balance international and domestic politics simultaneously (Moravcsik 1993, Putnam 1988) opens up a considerable role for sub-national, national and trans-national non-governmental actors in climate negotiations. These actors are important for various reasons. Sub-national stakeholders often help to set the agenda in their own countries (Susskind and Ozawa 1992). Their contributions can shape climate agreements and their support can be essential for implementation; for example, the cooperation of industry, energy sectors and the scientific community is increasingly important in designing actions and targets. Environmental NGOs can help to bring about a change in attitudes in the transport and residential sectors (Japanese Ministry of Trade and Industry 2004), and they can also educate the public and rally support for the climate cause through the media (Susskind and Ozawa 1992). Even if a country doesn't join a global agreement, it doesn't prevent sectors from that country from voluntarily participating in green initiatives. US companies, such as those belonging to the Pew Center's US Business Environmental Leadership Council, may well be willing to participate in mitigating initiatives such as emissions trading even in the absence of any commitment by their national government (Pew 2005). Finally, Southern NGOs and civil society are crucial allies, and support for these groups can only serve to increase the chances of convincing developing countries to sign up to a future climate agreement (Ott et al. 2004).

V. Leadership

i. Leadership is vital

Leadership is vital to further action on climate policy. The EU together with other pro-active countries must take on leadership to support negotiations on post-2012 climate policy in various ways. Young (1991) identifies three leadership types: structural (power and resources); entrepreneurial (mediator and negotiation skills); and intellectual (promote principles, shape mindsets, and agendas). As an important negotiator the EU, with support of other “coalition of the willing” countries such as Canada, Japan, New Zealand, Norway, Mexico, the Republic of Korea and Switzerland, should take on entrepreneurial leadership, and mediate with the USA and key developing countries. Likewise these countries, with support of research communities, business and other stakeholders with a pro-active attitude to climate policy in all countries, should show intellectual leadership to shape mindsets, and promote principles and agendas as a background for the negotiations.

Furthermore:

- The EU should demonstrate (and communicate) that by example it is a entrepreneurial and intellectual climate policy leader, both as a supranational organization and as chair of meetings, bodies and committees in the UNFCCC and negotiation process when such occasions arise. The EU will only be seen to be a credible leader and negotiator if it is able to reach its own emission targets and demonstrate a willingness to sign up to further ambitious cuts. Setting future targets will send a clear message to the developing world that the North is taking the issue seriously. It will also give an unequivocal signal to the business community that it is worth investing in the development of new technologies in the medium- to long-term.
- An entrepreneurial leadership approach that includes nations and other stakeholders in the decision-making process should be adopted to stimulate collaboration.
- Entrepreneurial and intellectual leadership should be exerted in a subtle and conciliatory style, where the EU avoids imposing its perspectives and interests on other parties.
- The EU should get maximum bargaining leverage by showing awareness and understanding of all three facets of leadership (utilising hard power, soft power and negotiating skills)

ii. Improving political feasibility

Reframing the climate issue

- The EU should consider reframing issues that may trigger a favourable realignment of interests (e.g. climate as an integrated part of a sustainable development strategy).

Focal issues and issue-linkages

- Making issue linkages can be politically expedient (e.g. climate and development, co-benefits in developing countries, climate and air pollution, energy security, and green technologies): it can help to build bridges and establish a more broadly acceptable outcome.

Improving political awareness and sensitivity

- The EU should be politically astute. Attention should be paid to the signals that EU behaviour sends to its negotiating partners (e.g. meeting targets, setting new targets, being seen to listen and compromise).
- The political climate must be understood. It is important to start work immediately towards developing a clearer understanding of the positions and interests of its partners and how coalitions are likely to form and act in future negotiations.
- Awareness of terminology: A common negotiating vocabulary could be established that avoids terms with negative connotations to some actors (e.g. post-Kyoto vs. beyond 2012; burden-sharing vs. differentiated responsibilities; commitments vs. participation). This is a simple way of reducing tensions.

iii. Policy innovation

- Creative and ambitious policy solutions to the climate problem should be promoted.
- Flexibility should be built in to respond to changing circumstances.

- The EU should take a conciliatory approach to policy-making to counteract the perception that policy choice is imposed on other parties.

VI. Avoiding pitfalls

Four potential sources of negotiation 'failure' have been highlighted in the literature (Underdal 1983): uncertainty, inaccurate information, politically inadequate solutions and insensitivity to behavioural expectations. Assuming that the two last points are the major bottle-necks for post-2012 climate policy negotiations they deserve further attention.

i. Politically inadequate 'solutions'

Negotiations can fail when there is a misfit between what is seen to be a desirable solution in theory and what is a viable option in reality. Applied to the climate issue, this can be interpreted to mean that the ideal policy outcome on scientific, economic and political grounds may fail to coincide; for example, the most environmentally effective outcome may not correspond with the most economically efficient alternative, which may differ from the most politically feasible option. In order to avoid negotiation failure, actors should be pragmatic about what is actually achievable in political terms. It may help to view potential solutions as the common area in between three partly overlapping circles rather than distinct, irreconcilable endpoints. Successful negotiations will seek to identify and frame the climate issue in this area of common ground (or direct attention to the closest point to it).

In terms of the four agreement elements proposed and with reference to the assessment of parties' interest in section IV.i this means that elements must be designed so that they are at least acceptable to parties that rate their interest for one or more elements "low". To some extent there will be a trade-off between 'high', 'medium' and 'low' interest elements, and also with regard to design components of each element (e.g. the technology agreement).

ii. Insensitivity to behavioural expectations

A further possible cause of negotiation failure is the result of "process-generated stakes" (Underdal 1983). This notion assumes that parties not only have *substantive* expectations about issues and outcomes, but also *behavioural* expectations about the implications of their behaviour with respect to their image and reputation. In other words, "negotiation is not *only* a decision-making process; it is also to some extent an unofficial game of performance and reputation" (Ibid.: 190, Brown 1977, Iklé 1967). Actions must add credibility to the general positions or preferences that parties have committed to, which makes certain actions more politically beneficial or costly than others.

At the same time, process-generated stakes can contribute to negotiation success as well as failure. Understanding the positions and interests of negotiating partners as early as possible in the process can prevent hard-line positions from developing, and securing an early commitment to cooperation can provide the necessary incentive to overcome potential conflicts later on. Therefore an outcome should be sought that avoids perceptions of winners and losers, especially in an issue area such as climate where global participation is so essential.

VII. Main findings

The main results of the negotiation process analysis are summarized in Table 20.

Table 20: Main negotiation process findings

The negotiation process – Main findings

Timing. Negotiation planning should reflect the possibility of different scenarios with respect to a strong or weak agreement, and to early (before 2008) or delayed (around 2012) agreement.

Linking of agreement elements. The four agreement elements should be seen as integral parts of one framework. Flexibility and attractiveness is enhanced when each party can find something of high interest and is able to choose different profiles in terms of commitments across the agreement elements.

Building alliances. The interest of parties to the four agreement elements must be assessed. Negotiations must be based on the UNFCCC, and supplemented with informal discussions in smaller groups. The most willing parties should lead the way, and non-state actors be involved.

Linking with other issues. Linking negotiations to related issues such as development and climate, co-benefits in terms of reduced air pollution in developing countries, regional air pollution agreements, green technologies, and energy security, could be helpful for climate policy negotiations.

Leadership. Leadership is required from all pro-active parties in terms of meeting Kyoto commitments and showing willingness to further action. Framing, agenda and mediator leadership is required. Other nations and stakeholders must be involved, and awareness and understanding for their views and interests shown. Also, political awareness and sensitivity is important. Reframing issues, e.g. climate and development, and focal issues such as climate/green technologies, adaptation/mitigation, and climate/air pollution, can be helpful. Flexibility and policy innovation is required.

VIII. Conclusions

The analysis of agreement frameworks and negotiation strategies beyond 2012 lead us to propose that the EU should emphasise the following general elements in its climate negotiation strategy:

1. Promote flexibility and innovation in a multi-stage negotiation process, where the four agreement elements are seen as integral parts of one framework.
2. Seek issue linkages on important areas such as technology, energy policy, development, and air pollution since this can enhance negotiations.
3. Demonstrate framing, agenda and mediator leadership together with other pro-active countries.
4. Establish dialogue with key countries such as the USA, China and India, and be sensitive to their interests and concerns.
5. Stress informal processes; the importance of informal dialogue during pre- and negotiation periods, capacity-building, and promoting the participation of non-governmental actors.

Proposal for short-term actions for the EU and other proactive countries:

- a) Communicate in writing and speech EU's policy and national policies to other parties and stakeholders, and how they together work towards reaching the Kyoto targets and prepare for climate policies beyond 2012.
- b) Initiate collaboration with ten large and vulnerable developing countries on adaptation to climate change. A first step could be to organize visits to get a better understanding of adaptation needs, funding requirements and possible co-operation mechanisms in the

selected countries. The EU representatives should be scientists, engineers, policy experts, and high-level politicians.

- c) Organize an intergovernmental conference on forestry carbon dioxide emissions as part of future climate policy action, with inputs prepared by scientists, and leading up to policy discussions. The emphasis should be on framework, target, and delimitation issues, and further on to verification challenges.
- d) Develop an action plan together with developing countries to tackle issues where sustainable development and climate change are most strongly linked. Such issues are efficient technologies, security of energy supply (e.g. impact of high oil prices, and electricity shortages), and local air pollution. A first step could be to organize a conference on climate policy and energy security.
- e) Stimulate climate policy, energy and technology partnerships with the USA at federal, regional, state, city, town/municipality, and business levels. One idea is to explore linking of regional emission trading initiatives in the USA to EU's emission trading system.
- f) Establish collaboration on development and deployment of renewable energy, such as partnerships with the USA, Russia, China, India, and other interested countries.

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Annex 1. Key elements of the negotiation process

Our discussion of the key elements of the negotiation process is guided by advice from the political science literature and insights from past negotiation experiences. While the prerequisites for analysis may change over time (e.g. the positions and strategies of parties), we argue that the central components necessary for a successful negotiation process fall under four sub-headings: leadership, parties, processes, and politics.

I. Leadership: EU at the forefront

The importance of leadership in the complex domain of international negotiations is evident: "Experience in international governance indicates that in order to achieve progress ... leadership by a strong country or group of countries is required" (Ott et al. 2004: 7). The EU has long shown willingness to take up the leadership mantle on the climate issue, and so we begin by examining the multidimensional concept of leadership.

Oran Young (1991) argues that leadership is a necessary (but not sufficient) condition for reaching international agreement in a climate of complex interdependence. He distinguishes between three forms of leadership, at least two of which he believes must come into play in order to bring about negotiation success at the global level. He explains that a structural leader uses (hard) power and resources as a bargaining tool. An entrepreneurial leader, on the other hand, acts as a mediator and uses negotiating skills to frame issues, broker interests and promote consensus. Finally, an intellectual leader uses the (soft) power of ideas to promote principles and shape international mindsets and agendas. Young's perspective would therefore imply that awareness and utilisation of all three leadership instruments would serve to maximise the EU's leadership credentials. This perspective is reinforced by Gupta and Grubb (2000), who describe three similar modes of leadership under slightly different names (structural, instrumental and directional respectively), and Gupta and Ringius (2001), who go on to propose that the EU should combine these elements of leadership in a short, medium, and long-term strategy if it wishes to act as a leader in the climate policy regime.

According to Underdal (1994), leadership can be demonstrated through unilateral actions, coercion, and by combining skill, energy and status to activate instrumental techniques (Crump and Glendon 2003). Furthermore, specific leadership characteristics that have been identified as crucial for promoting agreement are: innovative thinking, creativity, problem-solving skills, and the ability to broker and make deals (Crump and Glendon 2003, Hampson and Hart 1995).

However, in the case of unilateral actions, some risk is involved if other parties do not eventually follow suit, since free-riding would reduce the efficiency of the European efforts at the global scale. There is also some risk of loss of competitiveness and jobs for the most exposed industries.

We proceed with a discussion of the other essential elements in the negotiation process before outlining a potential leadership strategy for the EU in future climate negotiations in Section III.

II. Parties: Building coalitions with key partners

Understanding the nature of the different parties' interests will be key to the success of future climate negotiations. As a potential leader, the EU could significantly boost its credibility by using the pre-negotiation period to demonstrate its willingness to listen to the ideas and concerns of others and incorporate them into a common global policy. Promoting international participation should be the lynchpin of an EU strategy, which we argue can best be achieved by building coalitions with key partners, developing strategies to re-engage sceptics (such as the USA and developing countries), and promoting the participation of non-governmental actors.

i. A coalition of the willing

Building a coalition of the willing to spearhead the climate change issue presents itself as the most promising means of injecting momentum into the negotiation process. This could supplement efforts to re-engage less eager partners (see following section), and act as a means of reinforcing rather than undermining a wider UNFCCC process seeking to achieve consensus at the global level. Potential partners include industrialised countries such as Canada, Japan, New Zealand, and Norway, and also the Environmental Integrity Group (currently, Mexico, the Republic of Korea and Switzerland), who have already demonstrated a commitment to environmental integrity in the Kyoto Protocol. As a team,

this coalition could lead by example; it could demonstrate its commitment to the climate cause by implementing ambitious climate policy targets, harmonizing domestic policies, developing collaboration forms that could be of interest to a wider group of countries, and acting as a springboard for climate policy innovation.

ii. Building bridges

With the USA unlikely to ratify the Kyoto Protocol, and a continued strained relationship between the EU and developing countries since COP8, considerable work needs to be done to bring reluctant partners back to the negotiating table.

The USA

A strategy to re-engage the biggest emitter of climate gases is necessary in order for any future climate regime to be economically efficient, environmentally effective and politically acceptable. Without the participation of the USA any global initiative would be seriously undermined; it would be difficult to imagine how the support of developing countries, and indeed some industrialised countries (e.g. Australia), could be won over.

A combined approach could potentially provide the best way forward. To start with traditional means, the EU (and possibly a small group of others) could engage in bilateral talks with the Federal Government to gain a better understanding of their concerns and identify scope for compromise. Instigating discussions both within and outside the Kyoto regime would be prudent given that the USA cannot participate at MOP meetings from COP11 (2005) onwards.³¹ Secondly, internal processes already underway in the USA could be supported politically and even financially (Ott et al. 2004). This could take the form of providing support to states, industry, interest groups, and scientific and local communities. Alliances could also be forged between the EU and sympathetic domestic political allies in the USA (e.g. the McCain-Lieberman coalition in the Senate, and political leaders in the pro-active Northeast states). Thirdly, efforts currently underway to highlight the synergies between climate mitigation/adaptation and technological innovation should be reinforced. Japan is a potentially useful ally in this issue area.

Developing countries

Developing countries have criticised the EU for being too focused on its own objectives and imposing its will on others. It is therefore of paramount importance that a future climate policy regime is made relevant to the broad majority of parties.

A main objection has been the elevated status awarded to mitigation in the Kyoto Protocol, despite repeated calls by the G77 and China for more attention to be paid to adaptation. The failure of COP8 to initiate discussion of post-2012 commitments has in part been attributed to the reluctance of Annex I (minus the US) to credit adaptation with a more central role (see e.g. Ott 2003). This theme should therefore play a central role in any future climate agreement.

Developing country representatives have also been critical about the EU's ability to understand the nature and diversity of negotiating coalitions. The G77 and China, for example, is a vastly complex group of over 130 developing countries, with diverse economic and political backgrounds. Their interests vary significantly, from OPEC, which is reluctant to mitigate and concerned for loss of oil revenue due to mitigation in other countries, to the AOSIS, whose very existence depends on arresting climate change.³² Other interests within the group are less clearly defined or mixed – such as the case of Bolivia, which is vulnerable to climatic change. Even OPEC itself, which might seem like a homogeneous group, represents eleven very different countries, including Algeria, Indonesia, Nigeria, Venezuela and Libya. A better understanding of the nuances between these groups and interests could prove to be a valuable political tool during future negotiations.

Moreover, it has been suggested that the disparate 'G77 plus China' lacks the leadership necessary to unite and coordinate it as a unified negotiation bloc. Efforts to encourage coalition-building in order to promote the emergence of a leadership group could free the block of its tendency to rule by lowest common denominator agreement (Ott et al. 2004: 8). China, India and Brazil, bolstered by a second tier of countries with rapidly expanding economies, could provide a counterweight heavy enough to keep even the traditionally obstructive OPEC in tow (Ibid).

³¹ MOP: Meeting of the Parties to the Kyoto Protocol.

³² AOSIS: Alliance of Small Island States.

Other key partners

Given the diversity of opinions and interests in the climate policy debate, it is likely that different partners will be valuable in different issue areas and for different reasons. In some cases, like-minded allies will be important; for example, the EU, the USA and Japan could form a natural alliance in promoting climate-friendly technology development and transfer. In other cases, it might be important to try to unite a cross-section of viewpoints in order to seek to identify a broader consensus. It is for this reason that a "New Triangle approach" has been proposed, focusing on dialogue between the EU, the USA and China (see first interim report for this project). Some have suggested that Russia could join this trio (Susskind and Ozawa 1992). Bringing together powerful representatives from key camps (in this case: climate-committed; industrialised climate-sceptics; and developing countries) challenges a few actors to identify a common interest and reach a consensus that could have considerable international resonance.

The importance of dialogue

As a warning of the consequences of failing to heed calls for an improved understanding of negotiating partners, Underdal (1983) cites uncertainty and inaccurate information as two main sources of negotiation failure. First, he argues that when actors feel they lack information that is pertinent to decision-making, it "tends to slow down the process and disturb the search for mutually advantageous solutions...it does so by making a party reluctant to make specific moves, by inviting insincere communication moves, and by tending to introduce a bias against solutions and moves that are novel or unfamiliar" (Ibid: 187-8). Second, (a) inaccurate information about other parties' preferences can affect a party's behaviour, and (b) a belief that an opponent misperceives a party's position can affect its own behaviour. The lesson in both cases is the importance of promoting dialogue to build an accurate picture of parties' interests and positions in order to prevent misunderstandings.

iii. Involving non-state actors

Understanding that states are not unitary actors, but must balance international and domestic politics simultaneously (Moravcsik 1993, Putnam 1988) opens up a considerable role for sub-national, national and transnational non-governmental actors in climate negotiations. These actors are important for various reasons. Sub-national stakeholders often help to set the agenda in their own countries (Susskind and Ozawa 1992). Their contributions can shape climate agreements and their support can be essential for implementation; for example, the cooperation of industry, energy sectors and the scientific community is increasingly important in designing actions and targets. Environmental NGOs can help to bring about a change in attitudes in the transport and residential sectors (Japanese Ministry of Trade and Industry 2004), and they can also educate the public and rally support for the climate cause through the media (Susskind and Ozawa 1992). Even if a country doesn't join a global agreement, it doesn't prevent sectors from that country from voluntarily participating in green initiatives. US companies, such as those belonging to the Pew Center's US Business Environmental Leadership Council, may well be willing to participate in mitigating initiatives such as emissions trading even in the absence of any commitment by their national government. Finally, Southern NGOs and civil society are crucial allies, and support for these groups can only serve to increase the chances of convincing developing countries to sign up to a future climate agreement (Ott et al. 2004).

III. Processes

"An approach to treaty negotiation that hangs on the single thread of formal, nation-to-nation interaction will not be as strong as a more elaborate set of interactions that weave together governmental and non-governmental interests" (Susskind and Ozawa 1992: 159).

Negotiation is a multi-stage (Salacuse 2003, Habeeb 1988, Zartman and Berman 1982) and multi-level process. In practice, the most promising approach is a multi-level negotiation arrangement, proceeding through several stages and taking place across several arenas. As already discussed in Chapter V, informal bilateral and multilateral talks with key actors could supplement more formal negotiations within the UNFCCC. In the following section, we identify important stages in the negotiation process and propose that parallel formal and informal processes offer a pragmatic way forward.

i. Negotiation: A three-stage process

Negotiation has been presented as a three-stage process, beginning with a diagnostic phase, proceeding to a formula phase and ending with a detail phase (Zartman and Berman 1982). According to theory, the diagnostic phase begins when parties recognize that a negotiated solution to a given problem is desirable, for example, they may appreciate that no single actor can achieve their objectives unilaterally. Once it has been established that there is a will to find a solution and parties reach a "turning point of seriousness" where they demonstrate a willingness to compromise, actors

move from the diagnostic to the formula phase (Ibid: 87). The second phase is characterized by a search for general principles, a common formula or a shared perception of the problem. If this is achieved, the negotiations can proceed to the final stage of the process where participants bargain over details. This last phase involves the kinds of activities usually associated with negotiations, such as parties presenting offers and demands, making concessions and finalising details before bringing the negotiations to a close.

ii. Parallel processes

As the UNFCCC provides a natural forum for formal discussions to take place, building on the existing UNFCCC process would be an obvious point of departure, using forums such as COPs, Subsidiary Body for Scientific and Technological Advice (SBSTA), and Subsidiary Body for Implementation (SBI).

However, building additional levels into the process could bring key benefits (Sugiyama et al. 2003). First, they could be mutually reinforcing, allowing bilateral and regional discussions to progress at a faster pace, and in turn, providing useful inputs to the slower-moving global process. Second, not only can informal negotiations inject momentum into the proceedings and represent valuable communications channels, but they can also provide a contingency plan should formal negotiation processes fail. A further rationale underpinning the multi-track option is the fact that the USA can only participate at MOP meetings as an observer. MOP1 will take place alongside with COP11 in November 2005.

iii. Informal processes

Critics argue that in past international environmental negotiations, inadequate attention has been paid to building up informal agreements prior to formal meetings, i.e. in the pre-negotiation period (Susskind and Ozawa 1992). To address this oversight, Sebenius (1991) advocates the use of informal preparatory workshops and educational events, and proposes that the conference structure is organised in a way that reduces the potential for conflict and confrontation; for example, by establishing advisory groups that incorporate diverse positions and cross-cutting coalitions of interests to help to diffuse tensions. While different processes might be suitable for different issues, potentially useful initiatives include: an informal seminar series to stimulate discussion about future climate negotiations, an extension of existing stakeholder consultation initiatives (such as the EU Future International Action on Climate Change Network (FIACC)) and the establishment of learning-based initiatives, public-private partnerships (EFIEA 2004) and dialogues to engage interest groups. Given that the USA will only be entitled to observer status at future MOPs, it is critical that formal and informal processes are initiated in order to retain US involvement in future negotiation processes.

IV. Politics

It has been argued that overemphasis on objectives has led the EU to pay insufficient attention to political feasibility and political processes (Grubb 2004). If the institution aspires to a leadership role, it should take care to tread a path that others are willing to follow. Acknowledging the importance of the following factors may help to secure a wider support base. First, fairness must lie at the heart of both future climate policy as well as the negotiation process itself. Second, process-generated stakes should be understood and dealt with sensitively. Third, solutions that are unlikely to be politically feasible at the global level should be reconsidered; and finally, making issue linkages and reframing the climate issue entirely (e.g. as a development issue) may be a politically expedient way of winning over sceptics and galvanising support for a global climate agreement.

i. Fairness

While negotiation theory often assumes that the primary motivation for actors is self-interest, it has been proposed that fairness concerns can also serve to: underpin the case for those who believe they have been unfairly treated; provide a "framework of soft constraints on the pursuit of self-interest;" and "provide decision premises where self-interest provides no clear guidance" (Ringius et al. 2002: 3).

The importance of fairness considerations in negotiating cooperation on global public goods is also strongly emphasised by Albin (2003), and provides a useful structure around which to frame a discussion on the issue. She proposes four strategies to promote fair negotiation practice: (1) improving negotiating and decision-making methods; (2) providing resources to disadvantaged parties; (3) promoting the participation of non-state actors; and (4) linking issues.

First, it is argued that decision-making processes should be inclusive, representative and transparent. This can be achieved by holding informal meetings, encouraging open dialogues, and initiating problem-solving workshops to foster trust and head-off any potential stalemates. Rules could even be established for what would constitute a fair negotiation process and outcome, and these could later be verified by a third party.

More resources could also be devoted to building the capacity of developing countries to participate in international negotiations (an issue also raised by Ott et al. 2004). This could take the form of training, policy advice, and research and technical support. Examples of initiatives offering negotiations support in the past have included the Africa Project, and the Latin America and Caribbean Project. However, there is evidence to suggest that the ability of developing countries to successfully represent themselves in global climate negotiations lags some way behind their capacity to protect their interests at WTO meetings (Page 2003). Improved technical support before and during meetings and training in negotiating procedures (and in some cases, languages) "would not only assist them: improving countries' ability to participate may lead to a more efficient outcome to negotiations and more legitimate outcomes" (Ibid: 10).

Furthermore, the involvement of stakeholders such as NGOs, business groups and scientists in the negotiation process, both at the national and international level, can add legitimacy to the policymaking process and improve the chances of a global agreement being implemented once they have been accepted. Finally, linkages can improve the fairness of negotiations if they contribute towards a more balanced agenda.

ii. Understanding process-generated stakes

A second possible cause of negotiation failure pointed to by Underdal (in addition to uncertainty and inaccurate information) is the result of "process-generated stakes" (1983). This notion assumes that parties not only have *substantive* expectations about issues and outcomes, but also *behavioural* expectations about the implications of their behaviour with respect to their image and reputation. In other words, "negotiation is not *only* a decision-making process, it is also to some extent an unofficial game of performance and reputation" (Ibid.: 190, Brown 1977, Iklé 1967). Actions must add credibility to the general positions or preferences that parties have committed to, which makes certain actions more politically beneficial or costly than others. At the same time, process-generated stakes can contribute to negotiation success as well as failure. Understanding the positions and interests of negotiating partners as early as possible in the process can prevent hard-line positions from developing, and securing an early commitment to cooperation can provide the necessary incentive to overcome potential conflicts later on. Therefore an outcome should be sought that avoids perceptions of winners and losers, especially in an issue area such as climate where global participation is so essential.

Avoiding politically unacceptable 'solutions'

Underdal (1983) identifies "politically inadequate solution design models" as a third potential source of negotiation failure. He explains that these can emerge when there is a misfit between what is seen to be a desirable solution in theory and what is a viable option in reality. Applied to the climate issue, this can be interpreted to mean that the ideal policy outcome on scientific, economic and political grounds may fail to coincide; for example, the most environmentally effective outcome may not correspond with the most economically efficient alternative, which may differ from the most politically feasible option. In order to avoid negotiation failure, actors should be pragmatic about what is actually achievable in political terms. It may help to view potential solutions as the common area in between three partly overlapping circles rather than distinct, irreconcilable endpoints. Successful negotiations will seek to identify and frame the climate issue in this area of common ground (or direct attention to the closest point to it), which links in closely with the following point.

iii. Reframing the climate debate and making issue linkages

In the interest of both fairness and political expediency, there is a strong argument for reframing the climate change debate as a development issue. This approach has been proposed by numerous commentators (Davidson et al. 2003, Najam et al. 2003, Beg et al. 2002, Metz et al. 2002, Winkler et al. 2002, Sebenius 1991). In addition, there is also a case for making issue linkages, that is drawing a connection between two issue areas only weakly related in order to broaden their appeal. Not only have developing countries themselves expressed a desire to make such linkages, but commentators have been quick to point out that in the face of uncertainty, "linkage may be crucial" (Susskind and Ozawa 1992: 153).

Reframing the climate change issue as a development issue or a technological challenge would free it from some of the negative connotations it has developed in recent decades. It is not difficult to see how the way a negotiation is framed can affect the way risk is perceived, "Loss-framing can contribute to resistance in concession making and risk-avoiding behaviour and is less likely to result in agreement. Gain-framing can contribute to risk-seeking behaviour and is more likely to result on agreement" (Crump and Glendon 2003: 215). The concept of "burden sharing" in climate policy can be seen as an example of "loss-framing", whereas "reducing climate change impacts" is an example of "gain-framing".

Turning back to issue-linkage, in his investigation into why states cooperate, Haas (1980) argues that making issue linkages can offer greater hope for an efficient outcome when international negotiations revolve around a dynamic issue where knowledge is uncertain and solutions are unclear, which presumably would fit the description of climate change. He goes on to explain that issues that were previously viewed as unrelated or even conflicting can become linked, and therefore lead to global cooperation, through a process of learning. This process can be interpreted as a realignment of interests so that the perceived benefits accrued to the different parties shift from incompatibility to congruence.

We briefly examine the issues that could provide a basis for making linkages and reframing the climate change question.

Development and climate

Mainstreaming climate policy into development issues is crucial for persuading developing countries that climate change is relevant to them. Key actors such as China, Brazil and India see development as a primary concern and only by framing the climate issue as a development question can broad cooperation be expected.

Impacts, adaptation and vulnerability

Giving a more even treatment to impacts, adaptation and vulnerability alongside mitigation in future negotiations would demonstrate a clear willingness on the part of the EU to address the concerns of non-Annex I Parties and thus remove a major obstacle to reaching an agreement.

Technology development and transfer

Sending out the clear message that addressing climate change provides an *opportunity* to stimulate the economy rather than a threat to growth is perhaps one of the most promising means of engaging the USA in the climate policy process. An EU "vision on technology" (as discussed in first interim report) could explore opportunities for cooperation with the USA on technology development. Emphasizing competitiveness – an area of common interest for the EU and the USA – may appeal to the instincts of the USA and establish mutually beneficial political and economic partnerships that can be built upon in the future. Technology transfer might also be a way of bringing key developing countries, such as China, into a climate partnership. It would no doubt also be of interest to important technological innovators like Japan.

Air pollution agreements

As many emissions sources release substances that are harmful to climate and air quality, integrating climate policy and air pollution agreements could provide a cost-effective solution to two environmental problems. While developing countries are primarily concerned with the immediate problems associated with local and regional pollution, reducing emissions as part of a dual climate-air pollution effort would potentially benefit not only local and regional inhabitants, but also their continental neighbours (e.g. the US, who receives airborne particles from Asia) and the global community (Rypdal et al. 2004; Holloway et al. 2003).

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